The Auk

A Quarterly Journal of Ornithology

Vol. 74 JULY, 1957 No. 3

PUBLISHED BY

The American Ornithologists' Union

CONTENTS

YELLOW-BELLIED FLYCATCHER NESTING IN MICHIGAN. By *Lawrence H. Walkinshaw* and *C. J. Henry*. 293

NESTING SUCCESS IN ALTRICIAL BIRDS. By *Margaret Morse Nice* 305

IN MEMORIAM: JOSSELYN VAN TYNE. By *Harold Mayfield* 322

THE SONG AND DANCE OF THE LONG-TAILED MANAKIN, *Chiroxiphia linearis*. By *Paul Slud* 333

AN EMBRYOLOGICAL COMPARISON OF THE DOMESTIC FOWL AND THE RED-WINGED BLACKBIRD. By *Joseph Carl Daniel, Jr.* 340

THE ARRIVAL OF CONTINENTAL MIGRANTS IN WESTERN JAPAN. By *H. Elliott McClure* and *Masashi Yoshii* 359

THE RESPONSE OF CHICKS OF THE FRANKLIN'S GULL TO PARENTAL BILL-COLOR. By *Elsie C. Collias* and *Nicholas E. Collias* 371

NOTES ON THE SONG SPARROWS OF THE MEXICAN PLATEAU. By *Allan R. Phillips* and *Robert W. Dickerman* 376

GENERAL NOTES

Species Limitation in Certain Groups of the Swift Genus *Chaetura*. By *Alexander Wetmore* . 383

The First Primary in Swifts. By *David Lack* 385

Two New Devices for Measuring the Shapes of Birds' Eggs. By *F. W. Preston* 386

Incubation and Nestling Periods of the Olive-sided Flycatcher. By *Lawrence H. Walkinshaw* and *C. J. Henry*. 389

Display of the Least Grebe. By *Dale A. Zimmerman*. 390

Flight Behavior of a Flock of Slate-colored Juncos in the Late Afternoon. By *Winifred S. Sabine* 391

Redheads Killed by a Downdraft. By *Henry Rate*. 391

Observations on the Diving of the Surf Scoter (*Melanitta perspicillata*). By *Philip S. Humphrey*. 392

Food of the Black Skimmer (*Rynchops nigra*). By *B. B. Leavitt* 394

The Gray Lag-Goose in Massachusetts: Correction. By *Dorothy E. Snyder* 394

REVIEWS 395

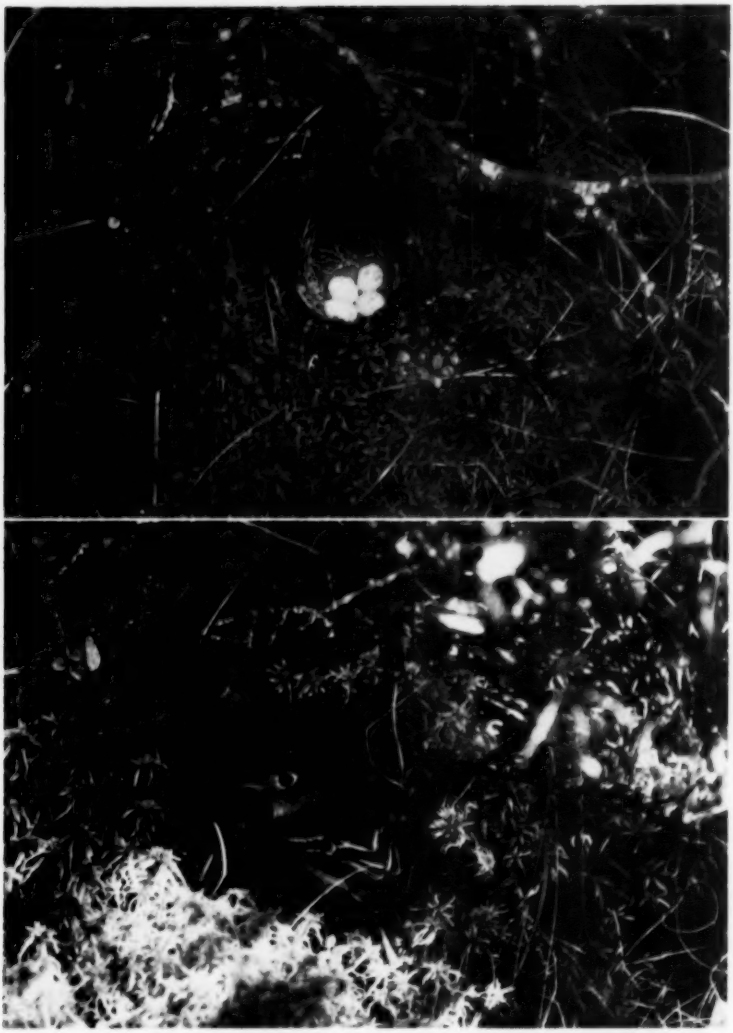
RECENT LITERATURE. Edited by *Frank McKinney* 401

NOTES AND NEWS 412

Printed by The Intelligencer Printing Company
Lancaster, Pa.

Entered as second-class mail matter in the Post Office at Lancaster, Pa., May 15, 1920, under the Act of August 24, 1912

Accepted for mailing at special rate of postage provided for in the Act of October 3, 1917, embodied in paragraph (d)—(2) of Section 34.40, P. L. and R., of 1948, authorized May 15, 1920.



NESTING OF THE YELLOW-BELLIED FLYCATCHER IN SCHOOLCRAFT COUNTY, MICHIGAN. (*Above*) Nests and Eggs, June 27, 1956. (*Below*) The female at the same nest, July 5, 1956. Photographs by L. H. Walkinshaw.

THE AUK

A QUARTERLY JOURNAL OF

ORNITHOLOGY

VOL. 74 JULY, 1957 NO. 3

YELLOW-BELLIED FLYCATCHER NESTING IN MICHIGAN

BY LAWRENCE H. WALKINSHAW AND C. J. HENRY

FOUR summer records of the Yellow-bellied Flycatcher (*Empidonax flaviventris*) were listed from Michigan by Norman A. Wood (1951: 271), from Chippewa and Gogebic counties and from Isle Royale. Three of these were specimen records. He did not list any actual breeding records.

Two recent records from Wisconsin show that the species definitely breeds in that state. A. W. Schorger collected a female June 22, 1949, in a spruce swamp near Teal Lake, Sawyer County, Wisconsin. She contained a well-developed egg. A male with greatly swollen testes was collected in the same region on June 22, 1950. Both specimens are in the collection of the University of Wisconsin (Schorger, in Kumlien and Hollister, 1951: 69). Lester Diedrich of the Milwaukee Public Museum collected a nest with four eggs and the female from the town of Wascott, Douglas County, Wisconsin, July 13, 1941 (Letter, Owen J. Gromme, September 17, 1956). These specimens are in the Milwaukee Public Museum. Kumlien and Hollister (1903: 82) wrote that Thure Kumlien took a nest with four eggs in the Bark River woods, Jefferson County, June 7, 1860, and two nests at a later date in 1863 and 1864. They also wrote that L. Kumlien found a nest containing two young just hatched, and one egg, June 25, 1891, near Albion, Wisconsin (Dane County). These records from Jefferson and Dane counties are much farther south than present-day records. No description of nests and eggs was given.

From Ontario, Baillie and Harrington (1937: 210) stated that the Yellow-bellied Flycatcher is not uncommon as a summer resident from the northern part of Wellington County to the transcontinental line of the Canadian National Railway, then west to Lake of the Woods at Indian Bay. Sets of four eggs were collected by L. S. Dear from

two different nests at Port Arthur, Thunder Bay District, one on June 24, 1934, and the other in late June, 1936. They also listed a nest with four small young found by E. Beaupre, July 1, 1921, at Amherst Island, Lennox and Addington County and recorded a female specimen (marked incubating) from Mer Bleue, June 13, 1891, found by F. A. Saunders.

Roberts (1932: 17) said that no actual nest had been found in Minnesota, but there were a number of summer records, specimens having been taken in Aitkin County, Itasca Park, Marshall County, St. Louis County, and Lake County.

The Yellow-bellied Flycatcher (Bent, 1942: 182) breeds north to southern Mackenzie, Ontario, Quebec, and Newfoundland; east to Newfoundland, Nova Scotia, New Brunswick, Maine, southern New Hampshire, southeastern New York (Slide Mountain), and northeastern Pennsylvania (Mount Pocono); south to northern Pennsylvania, southern Ontario (probably London and Listowel), southern Wisconsin, northern Minnesota, and southern Manitoba to central Alberta. During the winter it has been found from central Tamaulipas, Mexico, south through other Central American countries to Panama.

On June 24, 1952, Walkinshaw was with John Miller and Charles Price, Jr., in the great Tahquamenon Swamp, one half mile north of McMillan, Luce County, Michigan. John Miller, who had seen the species in New Brunswick, commented that he heard a Yellow-bellied Flycatcher calling. They approached and soon found two (apparently a pair). Although they spent some time in search of a nest, none was found. Two days later, William A. Dyer and Walkinshaw again searched the area, finding the two birds but no nest. The only call the birds gave was the "pee-wee" call.

On subsequent visits to the northern peninsula in 1953 and 1954 we failed to locate any of the birds. However, Walkinshaw located a singing male June 28, 1955, in the spruce-tamarack Tahquamenon Swamp about one mile west of McMillan, Luce County. Returning to this spot July 1, 1955, he again found a singing male. This was in Section 32, T46N, R11W. In this identical area, Powell and Betty Cottrille and Walkinshaw found two, possibly three, singing males on June 20, 1956, and Walkinshaw found one, July 4, 1956.

The Cottrilles, William A. Dyer, and Walkinshaw heard a male Yellow-bellied Flycatcher singing on June 18, 1956, a few miles south of Strongs, Chippewa County, Michigan (Section 7, T45N, R5W). This bird moved north along the highway, however, and soon disappeared in that direction. A few minutes later, they found another

singing male in a damp stand of black spruce (*Picea mariana*) and jack pine (*Pinus banksiana*). This male was definitely on territory. This was in Section 32, T45N, R5W (possibly just over in Sect. 5, T44N).

On June 23, 1955, Walkinshaw thought he saw a Yellow-bellied Flycatcher in a bog in northern Schoolcraft County, Michigan (Section 5, T47N, R13W), but he had not heard the species sing before and was not sure. However, on July 3, 1955, he and William Dyer heard a male giving the "Kill-ink" song in the very early morning as they entered the area to photograph an Olive-sided Flycatcher (*Nuttallornis borealis*), which was nesting in the bog.

The Cottrilles, Dyer, and Walkinshaw returned to the area on June 19, 1956. About 50 feet from where the Olive-sided Flycatcher nested in 1955, Powell Cottrille and Walkinshaw found a female Olive-sided Flycatcher building a new nest. Almost simultaneously Dyer found a Blue-headed Vireo's (*Vireo solitarius*) nest with four eggs in a nearby tamarack (*Larix laricina*).

The group separated and Walkinshaw soon observed that a female Yellow-bellied Flycatcher was carrying nesting material in front of him. She was giving the "Pee-wee" call and had her mouth full of small wisps of fine grasses. As he watched the bird, Betty Cottrille became aware of the same incident and soon they followed her to a definite spot at the base of a small black spruce. Here the nest was found sunken into the sphagnum moss. The top of the nest was slightly lower than the surrounding moss and was well formed. The female was making regular trips into the denser stands of taller black spruce to the south. As she returned, she stopped periodically in the spruce trees until she reached the nest area, where she dropped into the nest, leaving the new material. As she returned to the nest, she gave the "Pee-wee" call over and over. While returning for new material, she was quiet.

On June 22, 1956, at 6 A.M. they returned with Laurence C. Binford. There was one egg, wet with dew, indicating that it had been laid June 21. At 6 P.M. there were two eggs. On June 23, at noon, there were still two eggs but at 8 P.M. there were three, indicating that the eggs were laid in the afternoon. On June 24 both at 6 A.M. and 6 P.M. there were still three eggs, but on June 25 at 6 A.M. there were four. Since she was found building it, the female had not yet been seen on the nest. On the afternoon of June 25, from a distance of 20 feet, Walkinshaw observed the bird as she silently left the nest. On June 28, the No. 2 egg was collected (University of Michigan, Museum of Zoology).

A blind was erected in early July about 12 feet from the nest. Betty Cottrille and Walkinshaw spent separate periods watching the birds. When strobolite equipment was placed at the nest on July 3, the female would not return to the nest but sat in a nearby tree giving the "Pee-wee" call. On July 5 she showed signs of tolerance of camera equipment at seven feet. Consequently on July 6, in the early morning, Dyer and Walkinshaw tried to photograph with strobolite again. This time the female returned almost immediately. Henry took several more photographs after the young had hatched.

After the group left for southern Michigan, C. J. Henry, Ed DeRosia, and Robert Sundell examined the nest daily until the young departed. On July 9 at 7 A.M. and 4:30 P.M. there were still three eggs (Nos. 1, 3, and 4). On July 10 at 6 A.M. there were three young and no signs of egg shells in the nest. Incubation required 15 days. On July 21 the three young were well developed and one was taken by Henry (U.M.M.Z.). On July 22 in the late afternoon the young were still there, but on the morning of July 23 DeRosia found they were gone. He collected the nest (U.M.M.Z.). The nestling period was 13 days.

The nest of the Yellow-bellied Flycatcher was apparently built entirely by the female. The male was nearby but did no work. She must have hollowed out the spot in the sphagnum moss. Then, in this depression she brought an outside lining of an *Usnea*-type moss, black in color, which became darker when dried out. The sphagnum moss was damp during the entire nesting period and the water level, at times, must have been within one or two inches of the eggs. The nest was lined with light brown, dead grasses and sedges. After it was used, the inside diameter measured 53.4 mm. (in fresh condition, 48.2 mm.); depth, 24.9 mm. The outside diameter, side to side, was 81.3 mm. and from front to back, 96 mm. While sitting in the blind 12 feet from the nest, we could not see the female on the eggs unless she raised her head.

The four white eggs were laid at one-day intervals. They were sparingly covered with light brown spots, most of which were concentrated at the larger ends. Some were wreathed more than others. The largest spots were about one millimeter across, while the smaller ones were mere dots. The four eggs averaged 16.67 × 12.9 mm. in size and 1.67 grams in weight on June 28. The eggs, numbered as laid, measured 16.5 × 12.8, 16.4 × 12.8, 16.4 × 13, and 17.4 × 13 mm. in the order they were laid.

Usually the female left the nest silently when we approached, flying into one of the many surrounding spruces. From there she

flew out of sight into spruces farther away. When she returned, she gave a continuous "Pee-wee" call. In many instances she continued to give this call a few times when she was on the nest. Then she became silent until she returned again to the nest. After the young hatched, the parents rarely made a sound when coming to or going from the nest. Both male and female fed the young. The female, if brooding, often seemed afraid of the male when he brought food, backing off in a frightened attitude. The following notes were taken by Walkinshaw July 2, 1956 from a blind 12 feet distant:

11:16 A.M. Female back on eggs calling a low "Pee-wee" as she came toward nest. The male was with her and also gave the "Pee-wee" call. Both birds dropped onto the edge of the nest and both were now quiet. The male left immediately; the female began incubating. Two Nashville Warblers were singing steadily. A Myrtle Warbler, a Purple Finch, and a Blue-headed Vireo sang spasmodically. The Olive-sided Flycatcher called rarely nearby.

12:01 P.M. The female left the nest directly and silently.

12:08 P.M. Female was calling as she approached and flew from the taller spruces 15 to 25 feet down onto the edge of the nest. Then she hopped down onto the eggs. She gave the "Pee-wee" call 4 times on the eggs.

12:52 P.M. Female left the nest directly and silently.

12:58 P.M. Female returned and gave the "Pee-wee" call 6 times.

1:40 P.M. Female hopped silently to edge of nest, then flew onto a branch 3 feet, 6 inches away, then onto another nearby branch, where she sat for about one-half minute watching all around. Then she flew silently away.

1:45 P.M. Female was calling as she returned, 21 times, the last 2 on the nest. She landed on a small spruce nearby before flying down onto the nest. Olive-backed Thrush singing.

2:33 P.M. Female left the nest; flew into small spruce three feet to east. Here she sat for about one minute, then flew away. I got out and moved blind to within seven feet from nest.

2:41 P.M. Female was heard calling. Within range, she called 59 times, the last 7 from the nest. Apparently from her behavior she had not heard me move the blind. She must have gone some distance away for food.

2:55 P.M. Female rose a little, looked around, then settled back.

3:19 P.M. Female left nest, flew 3½ feet to southeast into a small spruce, and watched all around silently. After about one minute she flew away.

3:35 P.M. Female was heard calling 4 times but suddenly stopped.

3:40 P.M. Female came back, calling as usual. She called 56 times, the last 2 on nest.

3:52 P.M. The female was working with the eggs. A Ruby-throated Hummingbird was feeding on the Labrador tea.

4:11 P.M. Female left, silently flying away.

4:18 P.M. The female came back, giving the "Pee-wee" call 26 times, the last 2 on nest.

4:35 P.M. There was a slight noise nearby. The female left but returned immediately.

5:08 P.M. The female left suddenly and silently by same route.

5:17 P.M. As she returned, the female called 47 times, the last 4 from the nest.
5:21 P.M. The male called an explosive "Squeek" nearby twice; the female left suddenly. The male called three more times.
5:26 P.M. On returning, the female called 21 times, the last 2 on nest.
5:32 P.M. Olive-sided Flycatcher sang for the first time since I entered the blind. He had been giving the triple "Che-che-che" or "Cha-cha-cha" calls all afternoon.
5:55 P.M. The female rose, looked around, and left silently.

On July 3, 1956 Betty Cottrille took the following notes from the blind:

10:13 A.M. "Pee-wee" call heard. Other birds heard singing and calling were the Alder Flycatcher, Olive-sided Flycatcher, Golden-crowned Kinglet, Olive-backed Thrush, Blue-headed Vireo, Nashville Warbler, Mourning Warbler, and White-throated Sparrow. Strobolite placed two feet from nest.
10:15 A.M. "Pee-wee" call continued. Female approaching nest.
10:19 A.M. Bird on nest.
10:20 A.M. Male called "Kill-ick."
10:21 A.M. Female flew off nest and called "Pee-wee" once.
10:22 A.M. "Pee-wee" call continued; female came near, then went away.
10:24 A.M. Male called "Kill-ick"; female called "Pee-wee."
10:26 A.M. Same.
10:29 A.M. "Pee-wee" call heard in distance.
10:30 A.M. A small shrew went by the nest three feet away.
10:35 A.M. Camera taken down.
10:40 A.M. "Pee-wee" call given 46 times near nest; then the bird flew away, continuing to call.
10:45 A.M. and 10:48 A.M. Male called "Kill-ick."
10:49 A.M. Female called 24 times approaching nest.
10:50 A.M. Female on edge of nest, but flew away; both she and her mate continued to call. Behavior similar until strobolite removed at 11:01 A.M.
11:17 A.M. Female calling as she approached. She went onto nest, where she called twice.
11:20 A.M. Raven called and startled female.
11:21 A.M. Male came and sat on branch above nest, giving a throaty call and fluttering his wings. He shifted his position three times. (This could have been the female and the male might have been on the eggs.)
11:54 A.M. Incubating bird quietly raised up, looked around, and took off.
11:55 A.M. "Pee-wee" call in distance.
11:59 A.M. Female back onto nest without hesitating. Sharp-shinned Hawk scolding.
12:15 P.M. Bird raised up, looked from side to side, and left.
12:16 P.M. Female back, calling 3 times while settling onto eggs.

In the afternoon Walkinshaw was there at 2.

2:10 P.M. Female back, calling "Pee-wee" near blind.
2:21 P.M. Male chased something near nest; called a sharp "Kill-ink." Both birds gave the "Pee-wee" call.
2:22 P.M. Female on nest.

2:29 P.M. Male called sharp "Kill-ick."
3:19 P.M. Female left the nest after raising up and peering about. She landed 3 feet from nest, looked all around, then flew silently away.
3:25 P.M. Female calling over and over as she approached. She landed right on nest and immediately sank out of sight on eggs.
3:32 P.M. She tried to raise up and catch an insect over her.
3:35 P.M. She left quietly and quickly. Something had frightened her, for she remained very near nest.
3:41 P.M. She was back quietly this time. Not one call.
4:02 P.M. Ravens, calling from south, were flying over and came into nearby trees. Female left the nest before they came.
4:07 P.M. Ravens left to northeast. Sharp-shinned Hawk scolding them as they came over its nest about 400 feet away.
4:12 P.M. One Raven still nearby.
4:15 P.M. No Ravens calling now. Nashville and Myrtle warblers and Olive-sided Flycatchers scolding. Female came back, calling 12 times, then became silent.
4:27 P.M. Female had been sitting on a nearby branch for some time. Now she dropped silently onto nest.
4:58 P.M. Female left the nest, flying around behind the blind.

On July 4, she left the nest when a small airplane went overhead. Otherwise, her behavior was similar to that of July 2 and the afternoon of July 3. On July 6, Dyer and Walkinshaw set up strobolite equipment again within two feet of the nest. The female returned almost immediately and many photographs were taken. The male remained nearby throughout the morning. He called a sharp "Kill-ick" periodically. During the afternoons of July 4 and 5 he had not been heard nor seen.

Periods on the nest July 2 were 45, 44, 42, 48, 38, 31, 50, 4, and 29 minutes; periods away from the nest were 7, 6, 5, 8, 21, 7, 9, and 5 minutes. On July 3 periods on the nest were 37, 16, 57, 10, 21, and 31 minutes; periods away from the nest were 5, 1, 6, 6, and 25 minutes. On July 4 the female was on the nest for one recorded period of 40 minutes. On July 5 she incubated for two periods of 15 and 21 minutes and was away for periods of 12 and 10 minutes. The average time of 15 periods away from the nest was 8.9 minutes (1–25 minutes). The average period of incubation was 32.2 minutes (4–57 minutes) for 18 periods. Of a total of 712 minutes, 579 (81.3 per cent) were spent in incubation and 133 (18.7 per cent) away from the nest.

NESTING HABITATS

The area where we found the Yellow-bellied Flycatcher on territory in Chippewa County, Michigan, was a bog, drier than some, but with pools of water standing here and there. There were areas of higher, sandy land intermixed with the boggy areas. The area was

thickly covered with black spruce, some 25 to 30 feet tall, with small clearings in some places and scattered spruces in others. Many jack pines grew on the higher sand ridges among the spruce. The ground cover was mainly moss with Labrador tea (*Ledum groenlandicum*), swamp laurel (*Kalmia polifolia*), bog rosemary (*Andromeda glaucophylla*), and cassandra (*Chamaedaphne calyculata*), the predominant ground vegetation. The area along the Tahquamenon River near McMillan, Luce County, was similar but included much more sphagnum moss and larger numbers of tamarack (*Larix laricina*). There was no jack pine there, but a number of small deciduous bushes grew in places. In another area, still part of the Tahquamenon Swamp region (Section 36, T46N, R12W), Luce County, where Walkinshaw heard a singing male Yellow-bellied Flycatcher, July 4, 1956, there was less tamarack and more alders (*Alnus* sp?).

In the nesting bog in northern Schoolcraft County, some areas were covered with dense stands of black spruce; other areas with some tamarack with practically no ground cover. In between these dense timber stands were many clearings of different sizes. The Yellow-bellied Flycatcher seemed to use the edges of these clearings. The clearings had some of the plants found in Chippewa County—Labrador tea, swamp laurel, bog rosemary, and cassandra. But here we found several orchids: *Cypripedium acaule, Habenaria clavellata, Habenaria lacera, Calopogon pulchellus, Arethusa bulbosa.* (In the Tahquamenon Swamp area *Cypripedium parviflorum* was very abundant.) The large cranberry (*Vaccinium macrocarpon*) was abundant and small sedges (*Carex* sp?) grew here. Although the Yellow-bellied Flycatcher could have built its nest under ground vegetation, it selected a spot adjacent to a small black spruce where there was no ground cover above it at all. It was at the edge of a large clearing but adjacent to a thick black spruce area. Three different males were heard in this section. Two of them were in the bog clearings; the third was where the alders met the bog.

Bird species in the Schoolcraft County area were: Sharp-shinned Hawk (*Accipiter striatus*), Ruby-throated Hummingbird (*Archilochus colubris*), Flicker (*Colaptes auratus*), Hairy Woodpecker (*Dendrocopos villosus*), Alder Flycatcher (*Empidonax traillii*) (in the alders), Olive-sided Flycatcher, Hudsonian Chickadee (*Parus hudsonicus*), Red-breasted Nuthatch (*Sitta canadensis*), Golden-crowned Kinglet (*Regulus satrapa*), Ruby-crowned Kinglet (*Regulus calendula*), Cedar Waxwing (*Bombycilla cedrorum*), Blue-headed Vireo, Black and White Warbler (*Mniotilta varia*), Tennessee Warbler (*Vermivora peregrina*), Nashville Warbler (*Vermivora ruficapilla*), Parula Warbler

(*Parula americana*), Magnolia Warbler (*Dendroica magnolia*), Myrtle Warbler (*Dendroica coronata*), Blackburnian Warbler (*Dendroica fusca*), Canada Warbler (*Wilsonia canadensis*) (in the alders), Redstart (*Setophaga ruticilla*) (in the alders), Purple Finch (*Carpodacus purpureus*), Chipping Sparrow (*Spizella passerina*), and Lincoln's Sparrow (*Melospiza lincolnii*).

After the eggs hatched the adults became very quiet, and they became progressively quieter during the nestling period. Henry looked all over the swamp for them right after the young left the nest and could not find a trace of them. Sometimes, when one parent brought food while the other was at the nest, a very low note was emitted by one of the birds. On a couple of occasions Henry observed one parent give food to its mate, which in turn passed it on to the offspring. On two occasions the adult perched near the nest for several minutes at a time; it finally caught food from this perch. On other occasions the parents went for food far beyond Henry's field of vision.

The young in the nest were less active than most young birds. They were offered quite a contrast of foods. Characteristically, upon accepting food from the parents, they usually retaliated with a little white sac. Sometimes the parent swallowed the sac, but on a few occasions flew away with it.

The one young taken July 21, 1956, when it was 11 days old, weighed 11.3 grams. The wing measured 42.4 mm., tarsus, 15 mm., total length, 79 mm., and exposed culmen, 7 mm. The iris was dark brown. The tomia and lower mandible were lemon yellow; the upper mandible was dark tan (horn color). The legs were pinkish purple on the front, pale yellow posteriorly. (Colors were recorded by Robert Sundell from specimen taken by Henry.)

The bird was extremely yellow on the lower belly but much whiter on the throat and upper belly. Above, the bird showed a general olive-green appearance, tinged in places with brown and gray. The wing bars were also evident.

At the nest the adults showed the definite eye-ring and the two wing bars. The edgings of the secondaries showed lighter borders and the lower mandible was much lighter than the upper.

VOICE

The only call we heard the female Yellow-bellied Flycatcher give was the "Pee-wee" call. This call is definitely a "Position Call" as described for other *Empidonax* flycatchers by Davis (1954: 165–170). The female did not give it when leaving the nest, nor when away from

the nest. She did not give it when returning to feed the young. When she was frightened from the nest she did not give it on returning. However, while building the nest she gave it on each trip back to the nest, calling regularly and continuously, every few seconds. She gave it similarly when returning to incubate the eggs, even after she had settled down onto the eggs. After the hatching date she became very quiet. The male was heard to give this call on at least two occasions in Schoolcraft County and both birds were giving it in Luce County in June, 1952. The accent is on the second syllable and the call is not very loud. The Least Flycatcher (*Empidonax minimus*) has been heard by Walkinshaw repeatedly giving a "Position Call" of "Whit" usually as she returns to the nest. Another female Least Flycatcher call was described by MacQueen (1950: 203) as "Chweep." The Acadian Flycatcher (*Empidonax virescens*) was also heard in Muskegon and Calhoun counties, giving a "Position Call" of "Queep," again given by the female on returning to incubate the eggs. She has been heard to give this, though, when returning to brood the young or even feed the young out of the nest, as has the Least Flycatcher. The "Whit" call of the female Alder Flycatcher (*Empidonax traillii*) may possibly be a "Position Call," but the sharp "Queep" call is definitely not.

The typical call of the male Yellow-bellied Flycatcher is a double-syllabled, metallic "Kill-ink." It is not nearly as loud nor as explosive as the songs given by *E. minimus*, *E. virescens*, and *E. traillii*. It is given most often during the early morning hours. Walkinshaw has heard this song in Chippewa County, June 18, 1956; in Luce County, June 28 and July 1, 1955, and June 20 and July 4 (two areas), 1956; in Schoolcraft County, July 3, 1955, and repeatedly in late June and early July, 1956. Another song heard by the Cottrilles and Walkinshaw June 20, 1956, in Luce County was a "Pee-wick," also accented on the second syllable. These males were heard to sing from 8 to 16 feet up in 20- to 25-foot spruces. Between 9:51 and 9:56 A.M. a male sang the "Kill-ink" song from 9 to 12 times per minute, averaging 11 times. Later he gave the "Pee-wick" song 5, 5, and 4 times per minute for three consecutive minutes. A second male singing nearby gave the first song at about the same rate. Another call, which was not a song, given by the male when the birds were disturbed at the nest was a sharp "Kill-ick" much more explosive than the song.

For three of the *Empidonax* flycatchers in Michigan, Walkinshaw has heard a different call given in flight by the male near a known nest. The male has flown directly past him only a few feet away when giving these calls. Apparently it is to divert attention away

from the nest. The call was given by a male Yellow-bellied Flycatcher June 23, 1955, in Schoolcraft County when no nest was found and again by the male at the same area at a known nest in 1956. It consisted of many rapid short-syllabled notes. It has been heard only once when the intruder was near the nest. The Acadian and Least flycatchers have been heard giving a similar call during flight in Muskegon County, in July, 1956. In general, though, the male Yellow-bellied Flycatcher is a very quiet bird. Even then he is heard more than seen.

SUMMARY

Yellow-bellied Flycatchers were found in summer in the Upper Peninsula of Michigan, in Chippewa, Luce, and northern Schoolcraft counties. A nest was found under construction in Schoolcraft County, June 19, 1956. All observations were made in bog areas where black spruce, tamarack, and in one area, jack pine occurred. Undergrowth was predominantly sphagnum or other mosses, Labrador tea, swamp laurel, bog rosemary, and cassandra, with scattered cranberries, rare orchids, sedges, and grasses.

The nest was built by the female at the base of a small black spruce in a semi-open location, near both a clearing and a thick stand of black spruce. It was sunken into the sphagnum moss with no vegetation directly over it. It was built of black mosses and lined with dead grasses and sedges. Four eggs were laid from June 21 to the night of June 24–25. One egg was laid between noon and 8 P.M. Incubation began June 25 and the young hatched between 4:30 P.M. July 9 and 6 A.M. July 10, a period of 15 days. The four eggs were white, covered sparingly with light brown spots. They averaged in measurement 16.67 × 12.9 mm. and in weight on June 28, 1.67 grams. The young remained in the nest 13 days. The female did all of the incubating, but both male and female fed the young.

During 712 minutes of observation July 2, 3, 4, and 5 the female incubated 81.3 per cent of the time. The average period of incubation (18 periods) was 32.2 minutes (4–57), and the average period away (15 periods) was 8.9 minutes (1–25) for the remaining 18.7 per cent of the time.

While building the nest, when she returned with nest-material, and when she was returning to the nest to incubate the eggs, the female gave a low "Pee-wee" call accented on the second syllable. At all other times she was very quiet.

The male had a two-syllable song, "Kill-ink," not very loud, and also accented on the second syllable. It was given during one period

an average of 11 times per minute (9–12) during a six-minute period. Another song was "Pee-wick," given only 4 or 5 times per minute. The male was heard to give the "Pee-wee" call on three occasions. Another flight-call, with many rapid, short-syllabled notes, was given as the male flew by the intruder near his nest. But in general the male, too, was a very quiet bird.

We wish to thank for their help on this study W. Powell and Betty Cottrille, William A. Dyer, Ed DeRosia, and Robert Sundell. Without their assistance the study could not have been completed.

LITERATURE CITED

BAILLIE, J. L., and P. HARRINGTON. 1937. The distribution of breeding birds in Ontario. Part 2. Trans. Roy. Can. Inst., **21**: 199–283.

BENT, A. C. 1942. Life histories of North American Flycatchers, Larks, Swallows, and their allies. U. S. Natl. Mus. Bull. 179, 555 pp., 70 pls.

DAVIS, D. E. 1954. The breeding biology of Hammond's Flycatcher. Auk, **71**: 164–171.

KUMLIEN, L., and N. HOLLISTER. 1903. The Birds of Wisconsin. Bull. Wis. Nat. Hist. Soc., 3 (new series): iv + 143 pp. Illustrated.

KUMLIEN, L., and N. HOLLISTER, with rev. by A. W. SCHORGER. 1951. The Birds of Wisconsin. Wis. Soc. for Ornith., Inc., vi + 122 pp., 2 photographs.

MACQUEEN, P. M. 1950. Territory and song in the Least Flycatcher. Wilson Bull., **62**: 194–205.

ROBERTS, T. S. 1932. The birds of Minnesota. Vol. 2. Minneapolis, Univ. Minn. Press, xv + 821 pp., pls. 50–90.

WOOD, N. A. 1951. The birds of Michigan. Univ. Mich. Mus. Zool. Misc. Publ. No. 75, 559 pp., 16 pls.

1703 Wolverine Tower, Battle Creek, Michigan, and Seney National Wildlife Refuge, Seney, Michigan, October 5, 1956.

NESTING SUCCESS IN ALTRICIAL BIRDS

BY MARGARET MORSE NICE

NEARLY 20 years ago I presented a table in which it was shown that the percentage of success in 10 studies of open-nesting altricial birds averaged 43 for the eggs and 46 for the nests. I also pointed out that nesting success in hole-nesting altricial birds had been found to average about 66 per cent (1937: 143). This table on the open-nesters has been referred to by many workers; it seems high time to bring the subject up to date.

In Table 1, 35 studies are summarized on the success of altricial species that build open nests. Three of the papers in the 1937 table are omitted: Clabaugh (1926) because no information is given as to the species involved, Nice (1923) because most of this material is included in Nice (1931), and Walkinshaw (1936), since this study on 46 nests of the Field Sparrow is replaced by unpublished notes on 593 nests. The figures in Potter (1915) and Clabaugh (1925) have been altered by the omission of hole-nesting altricials and of precocial species. Because of the wealth of material a lower limit of 30 nests was set for this table. No nest is included unless at least one egg was laid in it; this rule necessitated recalculations with Howell's (1942) and Kendeigh's (1942) papers. Twenty-eight of the studies were carried out in the United States, six in Great Britain, and one in Germany.

Success of 7,788 nests was 49 per cent. Hatching success of 21,040 eggs was 60 per cent, while fledging success of 21,951 eggs came to 46 per cent. The corresponding figures in 1937 were: success of 814 nests, 46 per cent; hatching success of 1,994 eggs, 61 per cent; fledging success, 43 per cent. Now, with 10 times as many nests and eggs, the success of nests and fledging of eggs prove to be 3 per cent higher than before. The hatching success of eggs has dropped 1 per cent.

The success of hole-nesting birds averages distinctly higher than that of open-nesters. Table 2, largely taken from Table 9 in Allen and Nice (1952), summarizes hatching and fledging success in 20 studies in the New World and 13 in the Old. I have not included Creutz's (1949) study of the Tree Sparrow (*Passer montanus*), where only 379 young were fledged from 855 eggs (44.3 per cent), since the examination of the nests caused a considerable amount of desertion.

Hatching success of 34,000 eggs was 77 per cent; fledging success of 94,400 eggs was 66 per cent.

A further check on the validity of these figures may be obtained

TABLE 1

SUCCESS OF OPEN NESTS OF ALTRICIAL SPECIES

Species	Reference		Years	Nests Total	Nests Successes Number	Nests Successes Per cent	Eggs Laid	Eggs Hatched Number	Eggs Hatched Per cent	Fledged Number	Fledged Per cent
Mourning Dove	Nice	1931	8	249	130	52.8	500			213	42.6
Zenaidura macroura	Pearson	1939	3	592	309	52.2					
	McClure	1946	6	4273	2043	47.9	8018	4379	54.6	3734	46.6
	Monk	1949	9	235	122	52.0					
	Cowan	1952	4	204	142	69.6	398	310	77.8	274	68.8
Horned Lark	Pickwell	1931	2	30	18	60.0	102	79	77.4	46	45.1
Eremophila alpestris											
American Robin	Howell	1942	2	136	78	57.3	259	157	60.6	131	54.4
Turdus migratorius	Koehler	1945	1	64	49	76.6					
	Young	1955	3	176	86	48.8	548	316	57.8	246	44.9
Whinchat	Schmidt	1954	1	129	57	44.4					
Saxicola rubetra											
Cedar Waxwing	Putnam	1949	6	60	46	76.7	245	189	77.1	171	69.8
Bombycilla cedrorum											
Yellow Warbler	Schrantz	1943	2	41			168	119	70.8	91	54.2
Dendroica petechia											
Redwing	Williams	1940	1	67			214	156	72.9	105	49.1
Agelaius phoeniceus	Smith	1943	1	356			1140	823	72.2	675	59.2
Yellow-headed Blackbird	Fautin	1941	1	128			443	314	70.9	99	22.4
Xanthocephalus xanthocephalus											
Brewer Blackbird	LaRivers	1944	1	107	53	49.5	521	327	62.7	205	39.3
Euphagus cyanocephalus											
Bronzed Grackle	Petersen	1950	3	62	34	54.8	288	209	72.6	135	46.9
Quiscalus quiscula											
Goldfinch	Walkinshaw	1939	5	35	21	60.0	161	113	70.2	80	49.7
Spinus tristis	Stokes	1950	3	239			696	455	65.3	338	48.6
McCown's Longspur	Mickey	1943	3	45	27	60.0	153	92	60.1	71	46.4
Rhynchophanes mccownii											
Corn Bunting	Ryves	1934a	1	54			207			126	60.9
Emberiza calandra	Ryves	1934b	1	53	40	76.7	204			144	70.6

TABLE 1—*Continued*

Species	Reference		Years	Nests			Eggs				
				Total	Successes		Laid	Hatched		Fledged	
					Number	Per cent		Number	Per cent	Number	Per cent
Chipping Sparrow *Spizella passerina*	Walkinshaw	1952	12	88	55	62.5	277	185	66.8	170	61.4
Field Sparrow *Spizella pusilla*	Walkinshaw	(males)	10	593	226	38.1	1738	888	51.1	620	35.7
Song Sparrow	Nice	1937[1]	3	147	77	52.4	585	389	66.5	243	41.5
Melospiza melodia	Nice	1937[2]	4	76	30	39.5	321	147	45.8	80	24.9
7 Species—New Jersey	Potter	1915	4	43	18	41.9					
8 Species—Scotland	Praeger	1921	1	240	99	41.2					
10 Species—California	Clabaugh	1925	1	30	20	66.6	145	93	64.1	70	48.3
? Species—Scotland	Nicholson	1929	1	156			687	420	61.1	300	43.7
11 Species—England	Baron	1934	1	71			265	160	60.4	124	46.7
6 Species—England	Steuart	1939	1	113			428	295	68.9	248	55.6
11 Species—Ohio	Kendeigh	1942	19				2151	1317	61.2	1010	46.9
6 Species—Wisconsin	Young	1949	1	121	57	47.0	421	257	61.0	170	40.4
13 Species—Pennsylvania	Norris	1947	2	237			668	383	57.3	252	37.7
24 Studies: nest success				7788	3837	49.3					
26 Studies: hatching success of eggs laid							21040	12572	59.8		
29 Studies: fledging success							21951			10071	45.9

[1] First 3 years when the environment was favorable.
[2] Last 4 years when the environment was badly disturbed.

TABLE 2

SUCCESS OF SOME HOLE-NESTING ALTRICIAL SPECIES

Species	*Reference*		*Years*	*Nests*	*Eggs*	*Hatched*		*Fledged*	
						Number	*Per cent*	*Number*	*Per cent*
Tree Swallow	Chapman	1939[1]	9	219	1123	928	83.4	679	61.0
Iridoprocne bicolor	Low	1934	3	352	1759	1424	81.0	857	48.7
	Kuerzi	1941[2]	3	80	430	310	72.1	303	70.5
	Shelley	1937	2	37	184	163	88.6	123	66.8
	Weydemeyer	1935	8	60	363	358	98.6	340	93.7
Pied Flycatcher									
Muscicapa hypoleuca	Haartman	1951	8	221	1074			789	73.5
	Creutz	1955	13	606	3724	2632	70.7	2315	62.2
Black-capped Chickadee	Odum	1941	2	11	74			53	71.6
Parus atricapillus									
Great Tit	Gibb	1950[3]	5	202	1936	1653	85.4	1416	73.1
Parus major	Kluijver	1951[4]	19	5011	45466			29529	64.9
	Mackensie	1950	2	66	460	425	92.4	340	72.4
	Wolda	1929	2	623	6012	4579	76.2	3938	65.6
Blue Tit	Gibb	1950[3]	5	183	1887	1548	82.0	1453	77.0
Parus caeruleus	Huxley	1938	2		247	185	75.0	168	68.0
	Kenrick	1940	4	37	286	187	65.0	128	44.7
	Mackensie	1950	2	46	413	366	88.6	327	79.2
Coal Tit	Mackensie	1950	1	18	161	153	95.0	131	81.4
Parus ater									
House Wren	Kendeigh	1942[5]	19	1056	6773	5576	82.3	5351	79.0
Troglodytes aëdon	Kuerzi	1941	3	34	211	135	64.0	118	55.2
	McAtee	1940	6		469			399	83.7
	Walkinshaw	1941	21	64	333	199	59.7	161	48.3
Bewick Wren	Laskey	1946	15	21	129			79	56.8
Thryomanes bewickii									
Bluebird	Laskey	1943[6]	11	1401	6260	3943	63.0	2786	44.5
Sialia sialis	Low	1933	2	86	377	302	80.1	274	72.7
	Musselman	1935[7]	3	301	1290			839	65.0
	Thomas	1946	9	67	272	213	78.3	172	63.2
	Walkinshaw	1941	20	50	203	131	64.5	127	62.5

TABLE 2—*Continued*

Species	*Reference*		*Years*	*Nests*	*Eggs*	*Hatched*		*Fledged*	
						Number	*Per cent*	*Number*	*Per cent*
Starling	Lack	1948b			10557			7923	75.1
Sturnus vulgaris	McAtee	1940	6		472			410	84.5
Prothonotary Warbler	Walkinshaw	1941	11	121	413	159	38.5	106	25.7
Protonotaria citrea	Walkinshaw	1941	2	36	163	100	61.3	100	61.3
House Sparrow	McAtee	1940	6		114			97	78.5
Passer domesticus									
Five Species	Wolda	1929[8]	2		775			500	66.2
23 Studies (8 species) on hatching success					34000	26169	77.0		
33 Studies (13 species) on fledging success					94400			62331	66.0

[1] Records for 1938–1943 given in letter by L. B. Chapman.
[2] Number of "nests" in Kuerzi's table XVI should read "Pairs"; 11 repeat nests are cited in Table V and a second brood mentioned; total 80 nests.
[3] Totals for 1947–1951 given in letter by J. A. Gibb.
[4] Totals for 4 localities given in letter by H. N. Kluijver, observed for 12, 13, 14, and 19 years.
[5] See Nice, 1942.
[6] Totals for 1938–1949 given in letter by Amelia Laskey.
[7] With the addition of 67 eggs in 33 sets destroyed by April freeze, p. 120.
[8] Great Tit, Blue Tit, Coal Tit, Redstart (*Phoenicurus phoenicurus*), and Wryneck (*Jynx torquilla*).

by an examination of the frequencies of percentages of success as shown in Table 3.

TABLE 3

DISTRIBUTION OF PERCENTAGES OF HATCHING, FLEDGING, AND NESTING SUCCESS FROM TABLES 1 AND 2

	Open nests			*Hole nests*	
		Success of eggs		*Success of eggs*	
Percentage	*Success of nests*	*Hatching*	*Fledging*	*Hatching*	*Fledging*
20–29			2		1
30–39	1		3	1	
40–49	7	1	14		4
50–59	7	4	5		2
60–69	5	12	3	6	11
70–79	4	9	2	5	11
80–89				8	3
90–99				3	1
Median	52.5	64.7	46.9	78.3	66.8

With eggs in open nests, half the cases of hatching success fell in the sixties and half of those of fledging success in the forties. With the hole-nesting birds the largest percentages of hatching success of the eggs were in the sixties to eighties; of fledging, in the sixties and seventies.

As to success of nests, in the 24 studies of open nests where these figures are given, the majority fell in the forties and fifties. From these data it appears that about half the open nests of altricial birds in the North Temperate Zone succeed. This is five times the figure suggested by A. A. Allen (1930: 160). In all these studies in Table 1 nests were more successful than eggs, owing to the many partially successful nests. Egg success could exceed nest success in case of a high rate of desertion of incomplete sets, coupled with a high percentage of completely successful nests.

Eggs in partially enclosed nests—either domed or placed in niches—may have an intermediate rate of success, as pointed out by May (1947: 11) for the Willow Warbler (*Phylloscopus trochilus*) and Lack (1946: 130) for the European Robin (*Erithacus rubecula*). There are three studies on birds with domed nests. Of 244 Willow Warbler eggs, 213 (86.9 per cent) hatched and 138 (56.5 per cent) were fledged (May, 1949). During the three seasons, "human interference was in no year considerable" and the "weather showed no extremes." With the Chiffchaff (*Phylloscopus collybita*), of 235 eggs, 138 hatched (58.7 per cent) and 103 fledged (43.8 per cent) (Geissbühler, 1954).

Ovenbirds (*Seiurus aurocapillus*), studied for two seasons by Hann (1937), also showed no higher rate of success than open-nesters. Of 36 nests, 20 fledged young (55.5 per cent); of 161 eggs, 102 hatched (63.4 per cent) and 70 were fledged (43.5 per cent). A heavy loss—18 per cent—of eggs and young was due to parasitism by the Cowbird (*Molothrus ater*).

As to nests in niches, two cooperative studies by the British Trust for Ornithology have been published. With the Robin 71 per cent of 1,426 eggs hatched, and 77 per cent of 1,865 young were fledged. The "average success from egg to leaving nest" was 55 per cent (Lack, 1948c: 102). With Spotted Flycatchers (*Muscicapa striata*) 819 eggs hatched out of 1,052 laid (78 per cent), and of 749 hatchlings, 609 flew (81 per cent): hence over-all success is calculated as 63 per cent (Summers-Smith, 1952). With the House Finch (*Carpodacus mexicanus*) in Colorado, 166 young fledged from 283 eggs—59 per cent (Bergtold, 1913).

A study that is somewhat hard to classify is that on Orchard Orioles (*Icterus spurius*) on a refuge in Louisiana; of 157 eggs in 50 nests, 131 hatched (84 per cent) and 126 young were fledged (80.3 per cent). In these well-woven, semi-pensile nests, destruction of eggs and young "through predation constituted a very low percentage." But after leaving the nest at 12 to 14 days of age, the noisy fledglings, unable to fly, are highly vulnerable to raccoons, reptiles, and birds of prey (Dennis, 1948).

Success of nesting with passerines is influenced by the safety of the nest site; the percentage of eggs that hatch and are fledged typically falls in the sixties with hole-nesting species, perhaps in the fifties with birds with partially enclosed nests, and in the forties with those nesting in the open.

All these studies were made in the North Temperate Zone. The only paper I have found dealing with the success rate of more than 100 eggs in the South Temperate Zone is Bull's (1946) on two introduced species in New Zealand; their very low rate of success might be explained by an over-abundance of predators as discussed below. As to the tropics, the Moreaus (1940) speak of "the very high mortality in the nest" in Africa. In Central America, Skutch (1945) writes:

"Of 35 nests that I attempted to follow through in lowland forest in Panama, in 1935, only five, or 14.3 per cent, came to a conclusion—that is, produced at least one fledgling. In other forested regions of the lowlands, my luck has been scarcely better. But in the Guatemalan highlands, between 8,000 and 9,000 feet above sea level, 37 of 67 nests, or 55.2 per cent, were successful."

These nests were both open and enclosed. In another paper (1940) Skutch attributes this "astounding mortality of nests in the lowland forests . . . chiefly to snakes," although losses are also caused by Swainson's Toucan (*Ramphastos swainsonii*), Swallow-tailed Kite (*Elanoides forficatus*), and monkeys.

The site and architecture must afford some protection from the vicissitudes of the weather and from predators.

Is ground nesting more dangerous than bush or tree nesting? Kalmbach (1939) thought so. Examination of his sources, however, reveals that his tables are badly confused. Precocial and altricial species are mixed indiscriminately in his Table 1; sometimes hatching success is used, sometimes fledging, and even, in one case, fledging *failure* as "Per cent productive." Tables 2 and 3 are scarcely better. (See Nice, 1940.) Only in Table 4, "Nesting Success—Waterfowl," are we on surer ground, but even here the author does not discriminate between nests and eggs.

In Table 1 of the present study, the eggs of the 3 ground-nesting species had the following percentages of success: Horned Lark, 45; McCown's Longspur, [illegible]; Corn Bunting, 66. For the 3 species building domed nests on the ground, the percentages were 44 for the Ovenbird and Chiffchaff and 57 for the Willow Warbler.

Smith suggested that the high success rate of his and Williams' Red-wings—59 and 49 per cent respectively—might be explained by their comparative safety from ground predators due to nesting over water. But Fautin's Yellow-headed Blackbirds were markedly unsuccessful, largely because of severe storm damage.

Weather conditions may be disastrous—especially wind, rain, flood, drought, or excessive cold or heat. Here the hole-nesters have a great advantage in security of nest sites, although swallows and swifts may perish from starvation during cold, rainy periods. Drought can bring disaster to young waterfowl through the drying up of ponds and to passerine nestlings through diminishing the supply of insects. Storms have been responsible for heavy losses among Mourning Doves and Yellow-headed Blackbirds, while drought and flood wrought havoc with my nestling Song Sparrows. Early in the season eggs of Bluebirds, House Finches, and Horned Larks may be frozen.

A wide variety of enemies might be included under "predators" in the broadest sense of the term: typical predators—reptilian, avian, and mammalian, native and introduced—that eat the eggs and young; nest competitors that drive off the parents and sometimes destroy eggs or young; brood parasites, such as the Cowbird and Cuckoo (*Cuculus canorus*); arthropod parasites that prey on the nestlings;

man with his destruction of habitat and of the parents, eggs, and young, although at times his activities are helpful in the provision of nest sites and elimination of some predators.

Open-nesting passerines typically lose some 55 per cent of their eggs or young. Predators in the restricted sense of non-human animals, excluding the Cowbird, have been found to account for the following percentages of the total eggs: 24 (Young, 1949, for 6 species), 30 (Smith, 1943, Red-wings), 36 (Nice, 1937, Song Sparrows). The Ovenbird, despite its domed nest, suffered a 24 per cent loss from this source (Hann, 1937). Lack (1954: 77) thinks it likely that "in open-nesting song-birds over three-quarters of the losses of eggs and young are due to predation." In the above studies predation loss came to the following percentages of total loss: 40, 73, 55 and 43, respectively.

High incidence of predation decreased the rate of success in my Song Sparrows and La Rivers' Brewer Blackbirds. A striking example of this situation is afforded by the New Zealand study by Bull (1946) on the introduced Song Thrush (*Turdus philomelus*) and European Blackbird (*Turdus merula*). With the former, of 474 eggs, 172 hatched (36 per cent) and 105 were fledged (22 per cent); with the latter, of 201 eggs, 69 hatched (34 per cent) and 61 were fledged (30 per cent). Rats, stoats, cats, Starlings, children, wind, and hedge trimming were cited as inimical factors. In Great Britain, on the contrary, high success was found for the Song Thrush: of 739 eggs, 525 hatched (71 per cent); of 1034 hatched young, 808 were fledged (78 per cent); hence the percentage of eggs which produced young is calculated as 55 (Silva, 1949). These birds build secure nests reinforced with mud, as do American Robins, whose success proved high in two of three studies (Howell, 1942; Koehler, 1945).

As to hole-nesters, Lack (1954: 75) considers their high rate of success in comparison to open-nesters as "mainly due to the much smaller losses from predation." In Table 2 the two lowest percentages reflect severe predation and severe competition. In regard to the 44.5 per cent fledging success of 6,260 eggs of the Bluebird, "predators are chiefly responsible for the loss of eggs, young, and brooding females. Cats and snakes regularly climb to the boxes; there has been some depredation by boys" (Laskey, 1943: 39); while fire ants (*Solenopsis*) have also caused losses (Laskey, letter). The very low figure for the Prothonotary Warbler in Michigan—25.7 per cent for 413 eggs—was due to competition with an over-population of House Wrens. In Tennessee, without House Wrens, the success rate of 163 warbler eggs was 61.3 (Walkinshaw, 1941: 13).

The three studies of open-nesters where Cowbird parasitism was high show low fledging success of the host species: 35 per cent of 906 Song Sparrow eggs during 7 years (Nice, 1937), 36 per cent of Walkinshaw's Field Sparrows and 38 per cent for Norris' 13 species. The Ovenbirds with their covered nests should have had more than 44 per cent success.

As to nesting studies with higher success than usual, a variety of factors suggest themselves. Predation may have been lessened through human protection, as with Steuart's population in Essex, Kendeigh's House Wrens, and McAtee's Starlings and House Sparrows. This might also be the case with some of the marked successes of titmice in Great Britain.

Evergreens as nesting sites afford protection from storms and predators, as is evidenced by the high success rate of Walkinshaw's Chipping Sparrows and the Koehlers' Robins, as well as favoring an over-population of Bronzed Grackles (Sherman, 1928). Late nesters seem to be less harried by predators and sometimes by weather, as shown by the Goldfinches, Cedar Waxwings, and Corn Buntings. September nesting was far more productive with my Mourning Doves than spring nesting.

Parental devotion may also have an influence. Putnam (1949: 178) believed that the great success of his Cedar Waxwings was partly due to the constant attendance of one or both parents at the nest. Robins and Red-wings are bold in defense of their nests.

When nesting success proves to be markedly higher or lower than the norms found in these tables, it would seem advisable to search for especially favorable or unfavorable factors affecting the population. Ideally such a study should be carried on for a number of years. Fledging success of my Song Sparrows ranged from 19 to 46 during 7 years. It should be noted that only in one year—1930, which showed a success of 43 per cent—was I able to carry observations to the end of the nesting season; if this had been possible for the other years, nesting success would probably have been higher. Walkinshaw did pursue his studies throughout the season; the success rate of his Field Sparrows ranged from 30 to 48 per cent in 9 years. Lack (1946) reports fledging success of European Robins as ranging from 30 to over 70 per cent in different localities.

Since hole-nesting is so much more successful than open-nesting, one would expect hole-nesters greatly to outnumber open-nesters. Hole-nesting, however, presents difficulties, chiefly because of the limited number of holes. This may mean severe competition, with destruction of the eggs and young of less aggressive species by House

Wrens, Tree Swallows, Starlings, House Sparrows, European Tree Sparrows, and Wrynecks. Great Tits may even kill adult Pied Flycatchers (Haartman, personal communication). Or there may be intra-specific strife, as when first-year females arrive late in a nesting colony of Tree Swallows and break up mated pairs (Shelley, 1935). In a flock of "many thousands of Grey Starlings, *Sturnus cineraceus*," quarrels were staged between pairs for a nesting hollow "and almost ¼ of the flock seemed to have psychologically returned to non-breeding condition by lack of nesting site" (Kuroda, 1955). The dependence of the Purple Martin (*Progne subis*) on its highly specialized multiple nesting site, for which competition is keen, may be a reason for its very early and at times disastrous return from its wintering grounds in Brazil.

Hole-nesters spend more time fledging a brood than do open-nesters; clutches are typically larger, incubation is slightly longer and fledging as a rule markedly longer. For discussion of these subjects see Nice (1943: 70–71) and Lack (1948a: 29–41). Hole-nesting passerines leave the nest at a more advanced stage than do open-nesters; the former are able to fly from the nest, while the latter hop from it. Hence, hole-nesters are even more successful in comparison to open-nesters than the percentages indicate; 6 days after leaving the nest, the 46 per cent of fledged open-nesters have diminished to some extent.

TABLE 4

SIZE OF CLUTCH, LENGTH OF INCUBATION AND FLEDGING IN HOLE-NESTERS AND OPEN-NESTERS

	Locality	*Number of species*	*Average clutch*	*Average Duration of— Incubation*	*Fledging*	*Total days*
Hole-Nesters	Europe[1]	18	6.9	13.8	17.3	38
	U. S. A.[2]	10	5.4	13.8	18.8	38
Open-Nesters	Europe[1]	54	5.1	13.1	13.2	31.4
	U. S. A.[3]	11	4.0	12.0	11.0	27

[1] Lack (1948a), Table 3.
[2] Species from Table 2, this study, with addition of 3 more swallows.
[3] Species from Table 1, this study.

As shown in Table 4, for 18 European and 10 North American hole-nesting passerines the brood is vulnerable for an average of 38 days. For 54 European and 11 North American open-nesting passerines the brood is vulnerable for an average of 31 and 27 days respectively. The average loss of eggs or young to hole-nesters in Table 2 is 34

per cent, to open-nesters in Table 1, 54 per cent. A loss of 34 per cent in 38 days gives an average loss of 0.9 per cent of eggs or young per day. A loss of 54 per cent in approximately 29 days gives an average loss of 1.9 per day, twice the loss suffered by hole-nesters. Loss of nests, for open-nesters, averages 1.8 per cent per day.

On what basis can we compare nesting success of altricial and precocial birds? A precocial bird passes its whole nest-life within the egg, while an open-nesting altricial spends about half this period in the egg and half out of it. At leaving the nest, both birds have reached a somewhat comparable stage of development. Both are strong on their feet and both respond to parental notes of alarm. One is covered with down, the other with feathers. Peeking at food and drinking will come in a day or two for both. Both need parental care—the precocial must be brooded, and the altricial must be fed (Nice, 1943: 73).

Let us consider very briefly, with no pretense of covering the voluminous literature since Kalmbach's paper, the success rate of some precocial birds in comparison to altricials. Hickey (1955: 337), in a review of population problems in gallinaceous birds, found a hatching success of 35.5 per cent for 3,299 Phasianinae nests in 11 studies, and 51 per cent for 865 nests of Tetraoninae in 6 studies. "Nice's figure [of 46 per cent of 814 open nests of altricials] is almost matched by 44.5 per cent for 5,597 galliform nests."

If the galliforms in Hickey's table average a clutch of 11 eggs and an incubation period of 24 days, then a 55 per cent loss would mean a 1.6 per cent loss per day—much the same as with open-nesting passerines.

To judge from Kalmbach's Table 4 and Kiel's (1955) 4-year study in pot-hole country in Manitoba, waterfowl—at least diving ducks—would seem to have better success than galliforms. Kalmbach summarizes 28 studies on more than 7,600 nests of 13 species of ducks and the Canada Goose (*Branta canadensis*); the rate of success ranged from 29 to 85 per cent, averaging 60. Kiel found 73 per cent success with 227 nests of diving ducks and 50 per cent success with 149 nests of dabbling ducks. If we estimate 9 eggs per clutch for all the ducks and 26 days of incubation for the divers and 23 for the dabblers, we find 0.8 per cent daily loss for the former and 1.6 for the latter—the same as for the gallinaceous birds. The dabblers nest on the upland, the divers over water. In pot-holes, writes Kiel, "nesting over water is a distinct advantage because nests are largely protected against land-dwelling mammals and yet are not subjected to danger of destruction by wave action." Also these nests were safe from

sudden changes of water level occurring in connection with irrigation projects.

We must remember that all these percentages of success refer to nesting *attempts;* low percentages are usually compensated by an increase of attempts. Hickey suggests that "the larger clutch size of the single-brooded gallinaceous birds at least is in part counterbalanced by the multi-broodedness of passerine species." Some pairs of altricial species occasionally *raise* 3 or 4 broods, or even very rarely, 5 or 6—e.g., Mourning Doves (Cowan, 1952: 514; Monk, 1949: 4)—in a season. Such broods overlap, the father often caring for one brood until it reaches independence, while the mother incubates the next set. As a rule, multi-broodedness is more common with open-nesters than with hole-nesters. But this is not always so.

When a species consistently enjoys a high rate of nesting success, we can suspect that population increase may be limited in other ways. Or such over-success may lead to over-populations, as with House Sparrows, House Wrens, Starlings, Chipping Sparrows, Redwings, Grackles, and others.

The subject of nesting success has endless ramifications in the ecology and biology of each species, especially its longevity (Lack, 1950: 432) and its capacity to meet changing conditions. The wide range in the figures found by different workers for one species reflects the many variables that affect these aspects of a bird's life history.

It is a pleasure to acknowledge the kind assistance of Margaret Brooks Hickey, who listed all the reviews of nesting success in her unpublished index to 'Bird-Banding' from 1941 to 1950, and of Joseph J. Hickey and Lars von Haartman for advice in the preparation of this paper. I am also much indebted to the following fellow-workers who sent me unpublished data on their field studies: Lawrence B. Chapman, John Gibb, Harry W. Hann, H. N. Kluijver, Amelia R. Laskey, and Lawrence H. Walkinshaw.

SUMMARY

The success rate of open nests of altricial birds in the North Temperate Zone has been found in 24 studies on 7,788 nests to range from 38 to 77 per cent, averaging 49. In 29 studies involving 21,951 eggs, fledging success ranged from 22 to 70 per cent, averaging 46.

For hole-nesting altricial birds, fledging success of 94,400 eggs in 33 studies ranged from 26 to 94 per cent, averaging 66.

Fledging success in 6 studies on species with partially enclosed nests averaged 44, 44, 55, 57, 59 and 63 per cent.

Various favorable and unfavorable factors for nesting success are discussed.

In 18 European and 10 North American hole-nesting passerines, the brood is vulnerable for about 38 days; a loss of 34 per cent of the eggs and/or young would average 0.9 per cent per day.

In 54 European and 11 North American open-nesting passerines, loss of eggs and/or young would average 1.9 per cent per day for about 29 days, while the loss of nests would average some 1.8 per cent per day.

A newly-hatched precocial bird corresponds in some respects to a passerine that has just left its open nest. A success rate of 45 per cent was found in 5,597 galliform nests; the loss here might average 1.6 per cent per day. An average loss of 0.8 per cent of the nests per day was found for diving ducks nesting over water in pot-holes, and of 1.6 per cent per day for dabbling ducks nesting on the uplands.

The figures for nesting success refer to nesting attempts; low percentages are usually compensated by a larger number of attempts.

LITERATURE CITED

ALLEN, A. A. 1930. The book of bird life. New York, Van Nostrand.

ALLEN, R. W., and M. M. NICE. 1952. A study of the breeding biology of the Purple Martin (*Progne subis*). Amer. Midl. Nat., **47**: 606–665.

BARON, S. 1934. Nest mortality. Brit. Birds, **28**: 77.

BERGTOLD, W. H. 1913. A study of the House Finch. Auk, **30**: 40–73.

BULL, P. C. 1946. Notes on the breeding cycle of the Thrush and Blackbird in New Zealand. Emu, **46**: 198–218.

CHAPMAN, L. B. 1939. Studies of a Tree Swallow colony. Bird-Banding, **10**: 61–72.

CLABAUGH, E. D. 1925. Casualties among birds. Condor, **27**: 114–115.

CLABAUGH, E. D. 1926. Casualties among birds. Condor, **28**: 128.

COWAN, J. B. 1952. Life history and production of a population of Western Mourning Doves in California. Calif. Fish and Game, **38**: 505–521.

CREUTZ, G. 1949. Untersuchungen zur Brutbiologie des Feldsperlings (*Passer m. montanus* L.). Zool. Jahrb., Abt. Syst., **78**: 133–172.

CREUTZ, G. 1955. Der Trauerschnäpper (*Muscicapa hypoleuca* [Pallas]). Journ. f. Ornith., **96**: 241–346.

DENNIS, J. V. 1948. Observations on the Orchard Oriole in Lower Mississippi Delta. Bird-Banding, **19**: 12–21.

FAUTIN, R. 1941. Development of nestling Yellow-headed Blackbirds. Auk, **58**: 215–232.

GEISSBÜHLER, W. 1954. Beitrag zur Biologie des Zilpzalps, *Phylloscopus collybita*. Ornith. Beob., **51**: 71–99.

GIBB, J. 1950. The breeding biology of the Great and Blue Titmice. Ibis, **92**: 507–539.

HANN, H. W. 1937. Life history of the Ovenbird in southern Michigan. Wilson Bull., **49**: 145–237.

HAARTMAN, L. VON. 1951. Der Trauerfliegenschnäpper. II. Acta Zool. Fenn., **67**: 1–60.

HICKEY, J. J. 1955. Some American population research on gallinaceous birds. In "Recent Studies in Avian Biology": 326–396. Urbana, Ill., Univ. Illinois Press.

HOWELL, J. C. 1942. Notes on the nesting habits of the American Robin (*Turdus migratorius*). Amer. Midl. Nat., **28:** 529–599.

HUXLEY, J. S. 1938. Nests and broods in Whipsnade Sanctuary in two successive years. Proc. Zool. Soc. London, A: **108:** 445–452.

KALMBACH, E. R. 1939. Nesting success: its significance in waterfowl reproduction. Trans. Fourth No. Amer. Wildlife Conf.: 591–604.

KENDEIGH, S. C. 1942. Analysis of losses in the nesting of birds. Journ. Wildl. Mgt., **6:** 19–26.

KENRICK, H. 1940. A study of Blue Tits by colour ringing. Brit. Birds, **33:** 307–310.

KIEL, W. H., JR. 1955. Nesting studies of the Coot in southwestern Manitoba. Journ. Wildl. Mgt., **19:** 189–198.

KOEHLER, MRS. A., and G. KOEHLER. 1945. A bird study in the Madison Cemetery. Passenger Pigeon, **7:** 15–19.

KLUIJVER, H. N. 1951. The population ecology of the Great Tit, *Parus m. major*. Ardea, **39:** 1–135.

KUERZI, R. G. 1941. Life-history studies of the Tree Swallow. Proc. Linn. Soc. N. Y., **52–53:** 1–52.

KURODA, N. 1955. Field studies on the Grey Starling, *Sturnus cineraceus* Temminck. I. From winter to breeding season. Misc. Reports Yamashina's Inst. Ornith. and Zool., No. 7: 277–289.

LACK, D. 1946. Clutch and brood size in the Robin. Brit. Birds, **39:** 98–109, 130–135.

LACK, D. 1948a. The significance of clutch-size. III. Ibis, **90:** 25–45.

LACK, D. 1948b. Natural selection and family life in the Starling. Evolution, **2:** 95–110.

LACK, D. 1948c. Further notes on clutch and brood size in the Robin. Brit. Birds, **41:** 98–104, 130–137.

LACK, D. 1950. Population ecology in birds. A review. Proc. Xth Int. Ornith. Cong. Uppsala: 409–448.

LACK, D. 1954. The natural regulation of animal numbers. Oxford, Clarendon Press.

LARIVERS, I. 1944. Observations on the nesting mortality of the Brewer Blackbird, *Euphagus cyanocephalus*. Amer. Midl. Nat., **32:** 417–437.

LASKEY, A. R. 1943. The nesting of Bluebirds banded as nestlings. Bird-Banding, **14:** 39–43.

LASKEY, A. R. 1946. Some Bewick Wren nesting data. Migrant, **17:** 39–43.

LOW, S. 1933. Notes on the nesting of Bluebirds. Bird-Banding, **4:** 109–111.

LOW, S. 1934. Nest distribution and survival ratio of Tree Swallows. Bird-Banding, **5:** 24–30.

MACKENSIE, J. M. D. 1950. Nestling mortality amongst tits on Tentsmuir, 1949 and 1950. Brit. Birds, **43:** 393–398.

MAY, D. J. 1947. Observations on the territory and breeding behaviour of the Willow-Warbler. Brit. Birds, **40:** 2–11.

MAY, D. J. 1949. Studies on a community of Willow Warblers. Ibis, **91:** 24–54.

MCATEE, W. L. 1940. An experiment in songbird management. Auk, **57:** 333–348.

MCCLURE, H. E. 1946. Mourning Doves in Nebraska and the West. Auk, **63:** 24–42.

MICKEY, F. W. 1943. Breeding habits of McCown's Longspur. Auk, **60:** 181–209.

MONK, H. C. 1949. Nesting of the Mourning Dove at Nashville, 1949. Migrant, **20**: 1–9.

MOREAU, R. E., and W. M. MOREAU. 1940. Incubation and fledging periods of African birds. Auk, **57**: 313–325.

MUSSELMAN, T. E. 1935. Three years of Eastern Bluebird banding and study. Bird-banding, **6**: 117–125.

NICE, M. M. 1923. Nesting records from 1920 to 1923 from Norman, Oklahoma. Proc. Oklahoma Acad. Science, 3: 61–67.

NICE, M. M. 1931. Birds of Oklahoma. Univ. Oklahoma Biol. Survey, **3**(1): 1–224.

NICE, M. M. 1937. Studies in the life history of the Song Sparrow. I. Trans. Linn. Soc. N. Y., **4**: 1–247.

NICE, M. M. 1940. Review of Kalmbach's "Nesting success." Bird-Banding, **11**: 30.

NICE, M. M. 1942. Review of Kendeigh's "Analysis of losses." Bird-Banding, **13**: 90.

NICE, M. M. 1943. Studies in the life history of the Song Sparrow. II. Trans. Linn. Soc. N. Y., **6**: 1–328.

NICHOLSON, E. M. 1929. Birds. Encyclopedia Brittanica, 14th ed., **3**: 634.

NORRIS, R. T. 1947. The Cowbirds of Preston Frith. Wilson Bull., **59**: 83–103.

ODUM, E. P. 1941. Annual cycle of the Black-capped Chickadee. 2. Auk, **58**: 518–545.

PEARSON, A. M., and G. C. MOORE. 1939. Nesting habits of the Mourning Dove in Alabama. Trans. 4th No. Amer. Wildlife Conf.: 468–473.

PETERSEN, A., and H. YOUNG. 1950. A nesting study of the Bronzed Grackle. Auk, **67**: 466–476.

PICKWELL, G. B. 1931. The Prairie Horned Lark. Trans. Acad. Science of St. Louis, **27**: 1–153.

POTTER, J. K. 1915. Eggs and nestling destruction. Cassinia, **19**: 30–32.

PRAEGER, R. L. 1921. Birds' nests and their fate. Irish Naturalist, **30**: 25–26.

PUTNAM, L. S. 1949. The life history of the Cedar Waxwing. Wilson Bull., **61**: 141–182.

RYVES, COL., and MRS. B. H. RYVES. 1934a. The breeding-habits of the Corn-Bunting as observed in North Cornwall: with special reference to its polygamous habit. Brit. Birds, **28**: 2–26.

RYVES, COL., and MRS. B. H. RYVES. 1934b. Supplementary notes on the breeding habits of the Corn-Bunting as observed in North Cornwall in 1934. Brit. Birds, **28**: 154–164.

SCHMIDT, K., and E. HANTGE. 1954. Studien an einer farbig beringten Population des Braunkehlchen (*Saxicola rubetra*). Journ. f. Ornith., **95**: 130–173.

SCHRANTZ, F. G. 1943. Nest life of the Eastern Yellow Warbler. Auk, **60**: 367–387.

SHELLEY, L. O. 1935. Notes on the 1934 Tree Swallow breeding-season. Bird-Banding, **6**: 33–35.

SHELLEY, L. O. 1937. Further Tree Swallow notes. Bird-Banding, **8**: 80–81.

SHERMAN, A. R. 1928. Are birds decreasing in numbers? Wilson Bull., **40**: 29–38.

SILVA, E. T. 1949. Nest records of the Song-Thrush. Brit. Birds, **42**: 97–111.

SKUTCH, A. F. 1940. Some aspects of Central American bird-life. Scientific Monthly, **51**: 409–418; 500–511.

SKUTCH, A. F. 1945. Incubation and nestling periods of Central American birds. Auk, **62**: 8–37.

SMITH, H. M. 1943. Size of breeding populations in relation to egg-laying and reproductive success in the Eastern Red-wing (*Agelaius phoeniceus*). Ecology, **24**: 183–207.

STEUART, I. 1939. Number of nests and young reared in an Essex locality. Brit. Birds, **32**: 336.

STOKES, A. W. 1950. Breeding behavior of the Goldfinch. Wilson Bull., **62**: 107–127.

SUMMERS-SMITH, D. 1952. Breeding biology of the Spotted Flycatcher. Brit. Birds, **45**: 153–167.

THOMAS, R. H. 1946. A study of Eastern Bluebirds in Arkansas. Wilson Bull., **58**: 143–183.

WALKINSHAW, L. H. 1936. Notes on the Field Sparrow in Michigan. Wilson Bull., **48**: 94–101.

WALKINSHAW, L. H. 1939. Life history studies of the Eastern Goldfinch. Jack-Pine Warbler, **17**: 3–12.

WALKINSHAW, L. H. 1941. The Prothonotary Warbler, a comparison of nesting conditions in Tennessee and Michigan. Wilson Bull., **53**: 1–21.

WALKINSHAW, L. H. 1952. Chipping Sparrow notes. Bird-Banding, **23**: 101–108.

WEYDEMEYER, W. 1935. Efficiency of nesting of the Tree Swallow. Condor, **37**: 216–217.

WILLIAMS, J. F. 1940. The sex ratio in nestling Eastern Redwings. Wilson Bull., **52**: 267–277.

WOLDA, G. 1929. Verslag van de Ornithologische Afdeeling over het Jaar 1928. Plantenziektenkundige Dienst, Wageningen, pp. 1–27.

YOUNG, H. 1949. A comparative study of nesting birds in a five-acre park. Wilson Bull., **61**: 36–47.

YOUNG, H. 1955. Breeding behavior and nesting of the Eastern Robin. Amer. Midl. Nat., **53**: 329–352.

5725 Harper Avenue, Chicago 37, Illinois, June 16, 1956.

IN MEMORIAM: JOSSELYN VAN TYNE

BY HAROLD MAYFIELD

JOSSELYN VAN TYNE was a major figure in American ornithology. His reputation was international, and few men have had as wide an acquaintance and as high a reputation among bird students, amateur and professional. His published works give little hint of the influence he exercised. Probably his greatest contribution was made in the behind-the-scenes role of editor, counselor, and teacher. Yet his publications were substantial, even though his most ambitious projects were interrupted by death.

Josselyn Van Tyne was born May 11, 1902, in Philadelphia, Pennsylvania, the son of Claude Halstead Van Tyne and Isabella Joslin Van Tyne. His father was a distinguished historian, first at the University of Pennsylvania and then at the University of Michigan, where he eventually became Chairman of the History Department. Among his father's professional honors were appointment as visiting lecturer on two occasions in British and French universities and the award (posthumously) of the Pulitzer Prize in 1930 for the best book of the year in American history. The marriage of Josselyn Van Tyne and Helen Belfield Bates in 1933 united two prominent Ann Arbor families. Her father was the late Henry M. Bates, for many years Dean of the University of Michigan Law School and widely acclaimed as the man who brought that school to eminence.

Like many other ornithologists, Van, as he was known to most friends, showed an interest in birds early in life. This interest was stimulated by acquaintance with Norman A. Wood and others at the Museum of Zoology in Ann Arbor and by trips with his father, who enjoyed hiking and canoeing. As a man Van still recalled his sense of loss when his hand became too large to go into a flicker hole.

In his teens Van became tall, eventually reaching six feet, seven inches. Although his adult weight exceeded 200 pounds, his large frame seemed spare. In his teens he attended Culver Military Academy, where he won scholastic honors and medals for marksmanship. Both abilities were to serve him well in ornithology.

He earned the A.B. degree at Harvard in 1925 and the Ph.D. degree at Michigan in 1928, writing his doctoral thesis on the life history of the Short-keeled Toucan, *Ramphastos brevicarinatus*, for which he did his field work on Barro Colorado Island in the Panama Canal Zone. This was one of the first detailed life-history studies of a tropical species. His special interest in the toucans continued throughout his life.

JOSSELYN VAN TYNE

He joined the Museum of Zoology at the University of Michigan as Assistant Curator of Birds and in 1931 became Curator, a position he held until his death. In the Zoology Department, he was appointed Instructor in 1930 and advanced through the intervening grades to Professor in 1953. In recent years most of his teaching efforts were directed toward graduate students. Much of his teaching was done by counsel and example.

His accomplishments as Curator were impressive. During his period in the museum, the collection of bird skins was increased tenfold by additions from many parts of the world and enriched by other ornithological specimens, skeletons, eggs, and nests. Today it is one of the great research collections of the world, and is particularly rich in birds of North and Middle America and southern Asia, and in extinct forms. The ornithological library under his direction also grew from small beginnings to one of the best to be found anywhere. The collections were maintained with such orderliness and care that more than one private collector was prompted to deposit his own items there after a visit to Ann Arbor.

He had an instinct for collecting and kept some items that others might have discarded, but he did so in the conviction that certain things might have an unforeseen future value. His favorite adjective in describing a feature of the collection was "useful." He thought of the museum as a place to work. He encouraged sincere students to make use of the collection and was generous in loaning specimens, with due consideration for their safety.

Everything having to do with birds was of interest to Van, and his knowledge of ornithological literature was comprehensive. However, his research was principally in the fields of systematics, distribution, ecology, and life history. Most of his time was spent inside his office and the museum, but every year he aimed to get out at least once on an extended field trip. Over the years, his travels carried him to Indo-China (the Kelley-Roosevelt expedition of 1928–1929), the Panama Canal Zone, Guatemala, British Honduras, Yucatan, the Bahamas, Canadian Arctic, Europe, the Chisos Mountains of Texas, and nearly every part of Michigan. He was a productive collector, and thousands of near-perfect bird skins, many of them preserved under difficult tropical conditions, give evidence of his skill as a preparator.

His chief published works, in addition to the paper on the toucan, were as follows: two papers on the results of the expedition to Indo-China (with O. Bangs); "The Birds of Northern Petén, Guatemala" (1935); several papers on the birds of the Chisos-Rio Grande area of

Texas; "Check-List of the Birds of Michigan" (1938); several papers on the Kirtland's Warbler; the ornithological portions of "Island Life in Lake Michigan," published by Cranbrook (1948); and the chapters on the Kirtland's Warbler and Colima Warbler in Bent's "Life Histories" (1953).

The most important of his unfinished projects was his college textbook of ornithology, on which he had been working for several years. Another was his proposed monograph on the Kirtland's Warbler, which had been his principal field study for twenty-five years. In the last year of his life he was also engaged in preparing reports on the birds of British Honduras, Yucatan, and Bylot Island in the Canadian Arctic. It is expected that associates in these projects will carry them on to completion.

It was as an editor that Van did much of his best work. While editor of 'The Wilson Bulletin' from 1939 to 1948, he achieved a degree of perfection that set a new standard for ornithological journals. He was discriminating in his judgments of value and concerned that the literature not be burdened by trivial and verbose papers. He was meticulous about facts and checked references painstakingly. He was not only alert to ambiguity and obscurity but also sensitive to grace in the use of language.

The polished result was not accomplished without effort. Sometimes he put more work into editing papers than the authors did in the original writing. Some people leaned upon his editing until they seemed to give less care than usual to the preparation of papers sent to him, knowing he would "fix" them. Others resented the fine combing of their manuscripts, protesting that the final product was a "rehash." No editor could have tried harder to be diplomatic when asking, in effect, "Exactly what *do* you mean?" Few editors asked it as many times.

Everything that came to his hand received this same care—papers written by his students, papers issued through his division of the museum, rough drafts sent him for advice, and reports of committees on which he served, such as the A.O.U. Committee on Classification and Nomenclature. In giving so much attention to editorial matters, he was moved not only by a desire to help people but by a conviction that here he was fulfilling a need in ornithology. "How better can you teach?" he said. And indeed it is doubtful if some papers would ever have been put into suitable condition for publication without his guidance. His voluminous mail received the same conscientious treatment.

Much of his time for several years, for example, was spent in editing

and rewriting the manuscript of "The Birds of Michigan" by Norman A. Wood, after Mr. Wood's death. But his important role is not revealed on the title page of that work, nor is it adequately indicated elsewhere in the book.

For this anonymous and, at times, thankless contribution to ornithology, he paid a high price. His expenditure of energy was tremendous. He consulted with others, but he did not find it easy to delegate responsibility; therefore, the major part of each editorial burden fell on his own shoulders. His answer to this problem was unrelenting work. Seven o'clock in the morning found him at his desk. Unless he had a meeting or a guest, the evening found him steadily at work. This was the pattern nearly every day, with no exception for Saturdays, Sundays, or holidays. His idea of a vacation was a field trip, with correspondence still coming from his pen each evening. Although he was a man of wide interests, he deliberately rationed his attentions outside his professional field, with a sense of inner compulsion that there was so much to do and so little time to do it. In a characteristic statement for the twenty-fifth anniversary report of his Harvard class, he expressed satisfaction that his work was his hobby but regret that the days were so short.

In spite of this prodigious effort, his own scientific output suffered. He was constantly so busy readying other people's manuscripts for publication that he sometimes fell years behind schedule on his own. He was not a rapid worker, but his published notes and papers were models of clarity and precision.

Although he preferred to work alone and in his early career was inclined to view many human contacts as distractions, he later came increasingly to enjoy the company of people and to appreciate the importance of cooperative effort. He became an active worker in various organizations.

His towering figure was a landmark at A.O.U. meetings from the time of his joining in 1922. He attended the Denver meeting in September, 1956, although his physical condition required him to rest a part of each day. He served on many committees of the A.O.U., including the important Committee on Classification and Nomenclature for fifteen years, and was elected Fellow in 1936. As president from 1950 to 1953, he brought dignity and friendliness to the office. It was he who instituted the President's Coffee Hour at the annual meetings. On the Council of the A.O.U. he was a thoughtful and conservative force.

He also played a prominent part in the Wilson Ornithological Society. In addition to his ten years as editor of 'The Wilson Bulletin,'

he served as president from 1935 to 1937. For many years up to the time of his death, he provided the guidance for the Wilson Society library, making it possible for isolated students to have access to a first-class library by mail. He secured housing for this library in the museum and provided much of the care of it with his own hands.

He felt a strong responsibility toward the host of people with a slight interest in birds. He welcomed them in the museum, answered their letters courteously, and cultivated their friendship. For many years he was a member of the Advisory Committee of the Michigan Audubon Society and participated as an adviser in various local groups. He was the acknowledged authority on the birds of his state.

He was a member of the Board of the Cranbrook Institute of Science from 1934 and Chairman of its Committee on Publications from 1940 until his death. In 1954 he was president of the Ecology section of the International Ornithological Congress at Basel, Switzerland.

People meeting him for the first time usually found him somewhat formal, dignified, and serious—even to the point of austerity. This quality, combined with a keen, logical mind and a precise use of language, caused some people, including professional colleagues, to choose their words carefully with him. On the other hand, in congenial company he revealed a talent for humor, usually in the form of a gentle wisecrack—never acid nor personal. In times of relaxation, this was always close to the surface and added much to the charm of his personality. It bubbled up anywhere, any time; and his usual reserve left him completely in occasional moments of quiet, shaking laughter. His papers at the meetings of the American Ornithologists' Union were almost unique in that, although basically serious, they were enlivened by touches of humor. A small card on the outside of his office door, "Please knock and come in," gave visitors a hint of his reserve and friendliness.

He was never talkative and seldom revealed his inner thoughts. At times when traveling or camping, he would not utter a word for an hour or more and later would resume conversation on some commonplace subject, with no indication of his previous reflections. Unlike most of us, he seemed rarely to think aloud. On the other hand, he was friendly with people and generous with favors toward them, many of which he preferred to keep anonymous.

He was given to strong enthusiasms for people, often for people he knew only casually, a surprising trait in a man so analytical and detached about other matters. In idealizing certain of his friends,

he sometimes laid himself open to serious disappointment, because his high opinions did not always survive the strain of prolonged association or collaborative work. When people fell in his esteem, they fell far.

His standards were very high. But more significant in his personal relationships was the fact that he often saw issues of uncompromising principle in matters that to others were mere differences of opinion. To him such issues were black or white. Although controversy disturbed him, his strong sense of duty led him to champion more than one unpopular cause. In such instances, he had the courage to stand alone. His feelings in such matters were strong, but he showed the greatest restraint in commenting about them, and, if he named individuals at all, he leaned backward to be fair. I considered myself one of his more intimate friends for twenty years, but usually I learned only by inference or from another source that he was having a disagreement of a disturbing kind. While most of us blow off steam in the privacy of friendship, I can scarcely remember his offering an uncomplimentary remark about anyone. The rare exception was in those cases where people were being considered for appointment to responsible tasks, and he was under an obligation to express an opinion.

Although utterly out of sympathy with people he considered false to principle or failing to live up to their knowledge and abilities, he showed the greatest respect for and patience with sincere people, however limited their ability. His best friends were to be found in surprisingly diverse walks of life.

His basic gentleness was revealed in other ways as well. He was most reluctant to voice an opinion on political or religious issues for fear of hurting someone's feelings. He detested practical jokes.

He was a person of the highest integrity, unswervingly honest and true to his beliefs. Never once did he fight for his personal gain; it was always to defend a principle or a friend. He was exceptionally free of cynicism, convinced that right would prevail.

He reflected seriously on his own faults and worked unceasingly to overcome them. In fact, it would not be an exaggeration to say that a zeal for self-improvement was one of his dominant characteristics. It was revealed in his choice of reading material, the meetings he attended, and the notes he wrote to himself.

As his associate on more than a dozen field trips of one to five weeks each, I found him a perfect companion. In small matters, he was almost embarrassingly considerate and polite. Indeed, I was often hesitant to suggest a plan of activity for fear that he would

silently give up a preference of his own to go along with a lightly expressed choice of mine. He enjoyed company on trips but made little effort to coordinate his efforts closely with those of another person, preferring to work silently on his own independent investigations.

He was an intense field worker, and only one other matter took occasional precedence over his studies—his hearty appetite. He always made sure the car was stocked with groceries, and in mid-morning and mid-afternoon in the field I could depend on hearing the car door slam as he got a doughnut. His clock-like regularity of arrival at the luncheon site made it inevitable that he would be appointed camp cook, a task that he performed creditably.

The care with which he worked was characteristic of the man. He noted only what he saw unmistakably. He described his observations on the spot, using three-by-five-inch cards that he carried in his pocket. He distrusted his memory (which was excellent) and even his own senses, where his observations were brief or unsatisfactory. More than once I have heard him remark quietly, "This morning I saw a bird (or an event) that does not exist."

In the last year, his strength ebbed steadily and he knew he was dangerously ill, but he attempted to continue life as usual, saying as little about his condition as possible, even to his closest friends. In the summer of 1956 he managed to spend a few days in the field with his favorite study, the Kirtland's Warbler. Finally, when he became too ill to do creative work, he corrected proof on the Fifth Edition of the A.O.U. Check-List. To the end, his work was his life.

BIBLIOGRAPHY OF JOSSELYN VAN TYNE

1922

The Food of Long-eared Owls (with A. S. Warthin, Jr.). Auk, 39, No. 3 (1922): 417.

1923

Summer Birds of Les Cheneaux Islands. Wilson Bull., 35, No. 1 (1923): 21–26.

1924

Notes on Michigan Birds. Auk, 41, No. 1 (1924): 168–169.

1925

Bell's Vireo in Michigan. Ibid., 42, No. 2 (1925): 277.

Notes on the Birds of Charlevoix County and Vicinity. Papers Mich. Acad., 4 (1925): 611–627.

An Undescribed Race of Phainopepla. Occ. Papers Bost. Soc. N. H., 5 (1925): 149–150.

1926

New Winter Bird Records from Ann Arbor, Michigan. Wilson Bull., 38, No. 2 (1926): 117.

An Unusual Flight of Arctic Three-toed Woodpeckers. Auk, 43, No. 4 (1926): 469–474.

The Nest of *Automolus ochrolaemus pallidigularis* Lawrence. Ibid., p. 546.

1927

Fall Bird Notes from the Eastern Shore of Lake Superior (with William G. Fargo). Can. Field-Nat., 41 (1927): 7–9.

1928

A Diurnal Local Migration of the Black-capped Chickadee. Wilson Bull., 40, No. 4 (1928): 252.

1929

The Greater Scaup Affected by Lead Poisoning. Auk, 46, No. 1 (1929): 103–104.

Notes on Some Birds of the Chisos Mountains of Texas. Ibid., No. 2, pp. 204–206.

The Purple Gallinule (*Ionornis martinicus*) of Barro Colorado Island, Canal Zone (with A. O. Gross). Ibid., No. 4, pp. 431–446, pls. 20–24.

The Life History of the Toucan *Ramphastos brevicarinatus*. Misc. Publ. Mus. Zool., Univ. Mich., No. 19, 1929. Pp. 43, 8 pls.

Notes on the Habits of *Cyclopes dorsalis*. Journ. Mammal., 10, No. 4 (1929): 314, pl. 23.

1930

Status of Gambel's Sparrow in Michigan. Wilson Bull., 42, No. 2 (1930): 95–97.

Descriptions of Five New Indo-Chinese Birds (with Outram Bangs). Field Mus. Nat. Hist., Zool. Ser., 18, No. 1 (1930): 1–4.

The Barro Colorado Laboratory as a Station for Ornithological Research. Wilson Bull., 42, No. 4 (1930): 225–232, 7 figs.

1931

Birds of the Kelley-Roosevelt Expedition to French Indo-China (with Outram Bangs). Field Mus. Nat. Hist., Zool. Ser., 18, No. 3 (1931): 1–119, 3 pls.

1932

The 1931 Expedition to British Honduras and Guatemala. Rpt. Director Univ. Mich. Mus. Zool., 1930–1931 (1932): 18–22, 4 pls.

The Orange-crowned Warbler at Ann Arbor, Michigan. Wilson Bull., 44, No. 4 (1932): 234.

Winter Returns of the Indigo Bunting in Guatemala. Bird Banding, 3, No. 3 (1932): 110.

1933

The Arkansas Kingbird in Michigan. Auk, 50, No. 1 (1933): 107–108.

Some Birds of the Rio Grande Delta of Texas. Occ. Papers Mus. Zool., Univ. Mich., No. 255, 1933. Pp. 1–5.

A New Solitary Vireo from British Honduras. Ibid., No. 256. Pp. 1–2.

The Trammel Net as a Means of Collecting Bats. Journ. Mammal., 14, No. 2 (1933): 145–146.

The 1932 Chisos Mountains Expedition. Rpt. Director Univ. Mich. Mus. Zool., 1931–1932 (1933): 19–21, 3 pls.

Native Bird Traps of French Indo-China. Sci. Mo., 37, No. 6 (1933): 562–565, 5 figs.

1934

Edward Bruce Williamson. Auk, 51, No. 1 (1934): 134.

Pinicola enucleator eschatosus in Michigan and Ohio. Ibid., No. 4, pp. 529–530.

1935

The Birds of Northern Petén, Guatemala. Misc. Publ. Mus. Zool., Univ. Mich., No. 27, 1935. Pp. 1–46, 1 pl., folding map.

A New Red-tailed Hawk from Texas (with G. M. Sutton). Occ. Papers Mus. Zool., Univ. Mich., No. 321, 1935, Pp. 6.

The Occurrence of Sprague's Pipit in Michigan (with M. B. Trautman). Auk, 52, No. 4 (1935): 457–458.

1936

The Discovery of the Nest of the Colima Warbler (*Vermivora crissalis*). Misc. Publ. Mus. Zool., Univ. Mich., No. 33, 1936. Pp. 1–11, 4 pls., map.

Seven New Birds from the Punjab (with W. Koelz). Occ. Papers Mus. Zool., Univ. Mich., No. 334, 1936. Pp. 6.

Spizella breweri taverneri in Texas. Auk, 53, No. 1 (1936): 92.

Snowy Egret in Michigan. Ibid., No. 3, p. 322.

1937

South American Pied-billed Grebe in the Canal Zone. Ibid., 54, No. 3 (1937): 379.

Double-crested Cormorant Breeding in Michigan. Ibid., p. 381.

The Birds of Brewster County, Texas (with George M. Sutton). Misc. Publ. Mus. Zool., Univ. Mich., No. 37, 1939. Pp. 1–119, 6 pls., map.

1938

Check List of the Birds of Michigan. Occ. Papers Mus. Zool., Univ. Mich., No. 379, 1938. Pp. 1–44, map.

The Yucatan Form of West Indian Cliff Swallow (*Petrochelidon fulva*). Ibid., No. 385. Pp. 1–3.

1939

Kirtland's Warbler at Kalamazoo, Michigan. Auk, 56, No. 4 (1939): 480–481.

1940

Migrant Shrike in Michigan in Winter. Wilson Bull., 52, No. 1 (1940): 35.

1941

Early Records of the Clay-colored Sparrow in Michigan. Auk, 58, No. 3 (1941): 413–414.

New Birds from Yucatan (with Milton B. Trautman). Occ. Papers Mus. Zool., Univ. Mich., No. 439, 1941. Pp. 1–11.

1942

A Rock Wren Specimen from Michigan. Wilson Bull., 54, No. 1 (1942): 52.

Breeding-Bird Census of Jack Pine Barrens (with F. N. and F. Hamerstrom). Audubon Mag., Suppl., 44 (1942): 28, 30.

1943

'Anting' by the Robin and Towhee. Auk, 60, No. 1 (1943): 61.

A Peculiar Goshawk from Labrador. Ibid., No. 2, pp. 267–268.

Some Problems for Michigan Bird Students. Jack-Pine Warbler, 21, No. 1 (1943): 3–6.

Roseate Spoonbills Transported Northward by Ship. Wilson Bull., 55, No. 2 (1943): 127.

Abnormal Feather Loss by Cardinals. Ibid., No. 3, p. 195.

Breeding-bird Census of Jack Pine Barrens (with F. N. and F. Hamerstrom). Audubon Mag., 45, Sec. 2 (1943): 23–24.

1944

Breeding-bird Census of Jack Pine Barrens (with Harold Mayfield and Lawrence D. Hiett). Audubon Mag., 46, Sec. 2 (1944): 23.

American Ornithologists' Union Check-List of North American Birds (with A. Wetmore and others). 19th Suppl., Auk, 61 (1944): 441–464.

Norman Asa Wood. Ibid., No. 1, pp. 179–180.

A Specimen of Western Yellow-throat from Michigan. Ibid., No. 3, p. 475.

The Sex Ratio in Wilson's Snipe. Wilson Bull., 56, No. 3 (1944): 170–171.

The Nest of the Antbird *Gymnopithys bicolor bicolor*. Occ. Papers. Mus. Zool., Univ. Mich., No. 491, 1944. Pp. 1–5, 1 pl.

1945

A Melanistic Specimen of Wilson's Snipe. Wilson Bull., 57, No. 1 (1945): 75–76.

Migration Records from Yucatan (with M. B. Trautman). Ibid., No. 3, pp. 203–204.

American Ornithologists' Union Check-List of North American Birds (with A. Wetmore and others). 20th Suppl., Auk, 62 (1945): 436–449.

1946

The Red-winged Blackbird of Yucatan (with M. B. Trautman). Occ. Papers Mus. Zool., Univ. Mich., No. 496, 1946. Pp. 1–3.

Starling and Brown Thrasher Stealing Food from Robins. Wilson Bull., 58, No. 3 (1946): 185.

American Ornithologists' Union Check-List of North American Birds (with A. Wetmore and others). 21st Suppl., Auk, 63 (1946): 428–432.

1947

Kirtland's Warbler. In: A Field Guide to the Birds, by Roger Tory Peterson. Boston: Houghton Mifflin Co., 1947. Pp. 202–203.

American Ornithologists' Union Check-List of North American Birds (with A. Wetmore and others). 22nd Suppl., Auk, 64 (1947): 445–452.

1948

Island Life: A Study of the Land Vertebrates of the Islands of Eastern Lake Michigan (with Robert T. Hatt and others). Cranbrook Instit. Sci. Bull., 27, 1949. Pp. xi + 179, 23 pls., 1 map.

Home Range and Duration of Family Ties in the Tufted Titmouse. Wilson Bull., 60, No. 2 (1948): 121.

Eskimo Curlew and Whimbrel Collected in Newfoundland Labrador. Ibid., No. 4, p. 241.

American Ornithologists' Union Check-List of North American Birds (with A. Wetmore and others). 23rd Suppl., Auk, 65 (1948): 438–443.

1949

American Ornithologists' Union Check-List of North American Birds (with A. Wetmore and others). 24th Suppl., Auk, 66 (1949): 281–285.

1950

Bird Notes from Barro Colorado Island, Canal Zone. Occ. Papers Mus. Zool., Univ. Mich., No. 525, 1950. Pp. 1–12, 4 pls.

American Ornithologists' Union Check-List of North American Birds (with A. Wetmore and others). 25th Suppl., Auk, 67 (1950): 368–370.

Old Record of *Anhinga anhinga* Taken on St. Mary's River, Ontario. Ibid., pp. 508–509.

1951

A Cardinal's, *Richmondena cardinalis*, Choice of Food for Adult and for Young. Ibid., 68 (1951): 110.

Max Minor Peet (obituary notice). Ibid., pp. 135–136.

American Ornithologists' Union Check-List of North American Birds (with A. Wetmore and others). 26th Suppl., Ibid., pp. 367–369.

1952

The Distribution of the Kirtland Warbler (*Dendroica kirtlandii*). Proc. 10th Internat. Ornithol. Congr. (Sweden) (1952): 537–544, figs. 1–4.

Principles and Practices in Collecting and Taxonomic Work. Auk, 69, No. 1, (1952): 27–33.

American Ornithologists' Union Check-List of North American Birds (with A. Wetmore and others). 27th Suppl., Ibid., pp. 308–312.

Bird Records from New Providence and Eleuthera Islands, Bahamas (with Harold Mayfield). Occ. Papers Mus. Zool. Univ. Mich., No. 538, 1952. Pp. 1–4.

1953

Geographical Variation in the Blue-throated Hummingbird (*Lampornis clemenciae*). Auk, 70, No. 2 (1953): 207–209.

American Ornithologists' Union Check-List of North American Birds (with A. Wetmore and others). 28th Suppl., Ibid., pp. 359–361.

Vermivora crissalis (Salvin and Godman): Colima Warbler. U. S. Nat. Mus. Bull., No. 203 (1953): 126–129.

Dendroica kirtlandii (Baird): Kirtland's Warbler. Ibid., pp. 417–428.

1954

The Black-crested Titmouse of Trans-Pecos Texas. Auk, 71, No. 2 (1954): 201–202.

American Ornithologists' Union Check-List of North American Birds (with A. Wetmore and others). 29th Suppl., Ibid., pp. 310–312.

1955

Colima Warbler (*Vermivora crissalis*) in Colima. Ibid., 72, No. 1 (1955): 92.

Evolution in the Toucan Genus *Ramphastos*. Proc. 11th Internatl. Ornithol. Congr., Basel, 1954: 362–368.

American Ornithologists' Union Check-List of North American Birds (with A. Wetmore and others). 30th Suppl., Auk, 72 (1955): 292–295.

1956

The Scientific Name of the Florida Prairie Warbler. Auk, 73, No. 1 (1956): 139.

What Constitute Scientific Data for the Study of Bird Distribution? Wilson Bull., 68, No. 1 (1956): 63–67.

American Ornithologists' Union Check-List of North American Birds (with A. Wetmore and others). 31st Suppl., Auk, 73 (1956): 447–449.

1957

Kirtland's Warbler. In: The Warblers of North America, by Ludlow Griscom and Alexander Sprunt, Jr. New York: The Devin-Adair Co., 1957.

THE SONG AND DANCE OF THE LONG-TAILED MANAKIN, *CHIROXIPHIA LINEARIS*

BY PAUL SLUD

"UPON a bare branch which overhung the trail at a distance of about four feet from the ground, two male 'Bailadors' were engaged in a 'song and dance' act that simply astounded me. The two birds were about a foot and a half apart, and were alternately jumping about two feet into the air and alighting exactly upon the spot whence they jumped. The time was as regular as clock-work, one bird jumping up the instant the other alighted, each bird accompanying himself to the tune of 'to-lé-do—to-lé-do—to-lé-do,' sounding the syllable 'to' as he crouched to spring, 'le' while in the air, and 'do' as he alighted."

Thus did Charles C. Nutting (1884: 385), in Nicaragua, create the account of this bird's behavior which has maintained a lasting popular appeal. Indeed, in Costa Rica, where this bird is known as "el toledo," I have heard people tell the same story in almost exactly the same words while alternately raising each index finger to illustrate the quaintness of the performance.

Few succeeding writers have had anything new to say about this well-known bird. With one exception, they have contributed little more than notations which neither contradict nor necessarily endorse Nutting's remarks.

Only Nutting has clearly described the teaming of two males who behave like jumping jacks in an integrated dance. Carriker (1910: 683) states that he has seen the males jumping up and down on a branch, but he does not specify how many males dance at a time. He furnishes a bit of detail about appearance and posture, and describes a cracking noise produced by a snapping of the mandibles. Dickey and van Rossem (1938: 336–337) introduce the presence of a quietly perched female in front of and over whom the males leap back and forth rapidly and without pause. Also, they record bill snappings like those mentioned by Carriker.

The only extensive published observations on the Long-tailed Manakin seem to be those made in Chiapas by Helmuth Wagner (1946). He describes the courtship, call, nesting, and habitat, and includes a sketch illustrating the movements of the courting male. The observations of Dickey and van Rossem on the one hand, and those of Nutting and Carriker on the other, are apparently combined by Wagner in his statement that the dance consists of leaps from branch to branch around and above the female, and also of vertical

leaps into the air. In addition, the males hover in the air facing the female, who remains completely passive and indifferent ("indiferente"). Several males may perform at the same time. However, Wagner indicates that their efforts are not concerted, and implies that they are purely individual and probably competitive.

The above observers all agree that the males do dance or perform acrobatically and that the *tolédo* call is a constant accompanying feature. In other respects their views are at variance with one another. My own experiences with the bird in Costa Rica agree in small part with some of them, yet disagree in greater part with all of them. Much of what I saw was obviously different from what others had seen. Much that others had seen was never observed by me.

Possibly, the inconsistencies may eventually be resolved into complementary modes of behavior stumbled upon at random by different men in different places. I think it best, therefore, to present the bird as I have known it in Costa Rica.

I spent some five years in Costa Rica where I periodically visited those parts of the country inhabited by the Long-tailed Manakin. The range of the species is almost entirely confined to the northern half of the Pacific side of the country, from sea level to at least 4,500 feet in altitude. I have seen it in the edges of mangroves beside the coast, in the lowlands on both sides of the Gulf of Nicoya, along the western base of the Guanacaste Cordillera, upon adjacent, low portions of the continental divide, and on the central plateau to the west and south of San José. The period of greatest courting activity occurs during April and May, the months marking the end of the dry season and the beginning of the rainy season.

Throughout most of its range the bird is not uncommon, while in certain localities it is almost incredibly abundant. Nevertheless, in spite of having met with it many times, for a long while I did not succeed in finding performing males. This failure I attribute largely to a reliance upon preconceived ideas formed from the few references in the literature and from purported firsthand accounts related by people native to the country. Only through a lucky accident did I learn to find dancing birds by listening for one particular sound. Sometimes I witnessed a complete performance, more often only a part. A series of observations obviated the chief difficulties attending any one meeting: that is, getting to see the birds well and trying to record rapid action while not wishing to remove my eyes from the scene of activity to a notebook.

VOICE

The Long-tailed Manakin possesses a variety of notes and calls. Some seem to be produced only during the period of courtship but, as with a number of other kinds of manakin, the gathering of males into assemblies may cover much of the year.

The call which immediately identifies the species sounds like *to-lé-do* (*toe-lay-doe*), with the accent on the second syllable and a slight pause after the first syllable. It is uttered somewhat more slowly than a human being would pronounce it during ordinary speech. Some of the qualitative variations may sound like *taw-láy-daw*, *oo-wée-oo*, *oo-láy-oh*, or a sad *choo-hée-oo*. At times the call may be altered to a four-syllabled *wayco-tláyco*, and a several-syllabled *too-lée-oo·oo·oo·oo*. Not uncommonly the first syllable is omitted, the call, *wée-oo*, then becoming hard to distinguish from that of a distant Pauraque (*Nyctidromus albicollis*). A bird may omit the accent on the middle syllable and drop the pitch of the last one, resulting in a quite different *too-lee-yòo*. Often the regular *tolédo* call possesses a peculiar echoing character. This happens when two neighboring birds call in unison, an occurrence far too frequent to be classed as accident or coincidence.

Another call, not so distinctive of this bird in particular, is an arresting *whée·er hurr*, or *chéeoo hoo*, the first part of which is slow and stretched like an elastic. It may possibly bring to mind Prevost's Cacique (*Amblycercus holosericeus*).

Frequently given are from one to three or four *coo's or cow's* (really somewhere between *co* and *coo*). When given singly, the *coo* can be confused with the heavier note of the Rufescent Tinamou (*Crypturellus cinnamomeus*). When given three times in succession, with slight pauses between the notes, the call might easily be mistaken for that of a trogon, such as the Graceful Trogon (*Trogon rufus*), for example. The *coo's* may also be given in rapid succession without measurable pauses between.

Another common note is a sort of gargled *àhhhr* (or *uh·ahhhr*, one syllable) with the *àh* emphasized, the remainder of the note weaker and fading upward like a polite interrogation. A similar, but recognizably different, note is a whining *ăăăă* (or *wăăă*, or *măăă*). These are both antbird-like.

Still another common note is a musical, high-pitched, sudden *pyeek* (or *yeeik*, or *yeep*).

Heard less often is a reedy, rapid *kur·kur·kur·kur* etc., rather halting or, at least, unsteady.

Strictly associated with the actively dancing males are two other kinds of sounds to be described in the following section.

Thus, out of a patch of undergrowth may issue at intervals any of a number of different calls or notes all belonging to thes ame bird,—*chéeoo-coo; wăăă; yeeik; to-lé-do; coo-coo-coo; uh·ahhhr.*

ANTICS

The unmistakable *tolédo* advertises the presence of birds in an area. Should the call be traced, the observer will be rewarded by the sight of a beautiful bird of exotic appearance. He will not, however, find dancing birds. Despite citations to the contrary, in Costa Rica dancing birds do not utter the *tolédo* note. The note can be followed and birds stalked all day long yet never, in my experience, will they be surprised while engaging in a performance.

The trick is to get to know one particular note, a peculiar *miaow·raow* which is easy to learn and to remember. It is guttural, dry but resonant, rather cat-like, and bears no resemblance to the mellow *tolédo*. It possesses the quality of the similar notes of the Song Wren (*Leucolepis phaeocephala*), a bird which is absent from the Long-tailed's range. The *miaow·raow* is a double note repeated many times in succession. To the listener it provides the lead to birds dancing somewhere in the vicinity. To my knowledge this note is given at no other time.

Unlike the birds encountered by Nutting, performing males never seem to choose a trail. Unexceptionally the chosen site lies within twiggy undergrowth interwoven with vines, either in scrubby, dry forest or humid woodland, where a silent approach becomes an impossible feat during the dry season. Usually one or more, sometimes as many as six, males may materialize to examine the twig-snapping, leaf-crunching intruder. Once he is discovered, the observer's chances of viewing a performance become extremely poor.

Assuming that the source of the *miaow·raow's* has been approached with sufficient caution (easiest to do while the birds are actively engaged), the observer may perhaps glimpse through the cover a bird, or some object, rising and falling rhythmically. Or, if the notes have ceased, his attention may be attracted by what seem to be one or two Blue Morpho butterflies flying back and forth through the interlaced screen with an unwonted regularity. These are not butterflies, however, but two male manakins passing slowly in straight but apparently randomly directed paths between scattered perches. They fly with the weightless bounce of a Morpho, and the fluffed blue back makes them look like a Morpho. I am at a loss to explain

the mechanics by which the slow beats somehow sustain the retarded flight. At any rate, in this way the birds frequently fill an interlude between performances. By no stretch of the imagination could this aery floating be interpreted as a leaping back and forth from branch to branch, a type of behavior I have never witnessed nor ever been given cause to suspect in this species.

The observer will not have long to wait. The birds may have stopped floating back and forth but remained perched close by, constantly twitching their wings and uttering at intervals almost any of their notes. The *chéeoo hoo* note, incidentally, rather than the *tolédo*, seems both to draw the birds to a particular spot in the woods (extra males not taking part may surround the scene), and to signal the start of the show. Soon one and then a second male alights on a horizontal vine or slender branch, free from obstructions, low above the ground. The dance is now about to begin, and it may take either of two forms.

One dance starts, at least, the way Nutting described it, except for the absence of the *tolédo* note. Perched crosswise a foot or two apart, both facing in the same direction, the two birds alternately rise straight into the air for a foot or two. Each fluttering rise is preceded by a lowering of the head, and at the top of the rise the bird hangs suspended for an appreciable pause, as though attached to a rubber band. The red crown of the bowed head appears unusually large and bright, the sky-blue back loosely fluffed, the long tail arches and hangs in a graceful curve, and the bright orange legs hang too. A guttural *miaow·raow* punctuates each rise. Gradually the duration of each rise shortens and the rate of successive rises increases. As the tempo mounts, the crest of the risings falls lower and lower and the pitch of the accelerating *miaow·raow's* rises higher and higher until the former degenerate into seemingly uncontrolled flutters and the latter into unintelligible buzzy sounds. Now the birds hardly rise at all and almost bump each other as they flop about like helpless victims of an internal disorder. As though a switch were pulled, the orgiastic frenzy ends suddenly, and the birds cock their heads innocently in calm possession of faculties restored at the instant of reassertion of self-control.

The alternate dance, which may perhaps be the commoner of the two, begins after the same preliminaries as the preceding one. This time, however, the birds stand on the vine or branch lengthwise, both facing in the same direction but with one behind the other, again spaced more than a foot apart. The first bird, uttering his *miaow·raow*, rises straight into the air, where he then hangs momen-

tarily suspended. As he reaches the top of his leap, the rear bird, crouched, his eyes fixed upon the bird in the air, with rapidly flicking wings and arched tail hitches himself forward to the accompaniment of a low ticking, *pk·pk·pk·pk·pk* etc., to a point on the branch directly below the suspended bird and identical to the one from which the first bird rose. The bird in the air now falls diagonally backward to the very spot from which the bird below began his ticking, wing-quivering creep. As he alights, the second bird, now in the forward position, rises into the air. At the same instant the first bird, fallen to the rear position, hitches himself forward in his turn. Like balls in a juggling act, the birds replace one another with cyclical regularity. The individually uttered *miaow·raow's* accent the recurrent rhythm, and the underlying ticking goes on almost without interruption. The tempo may be increased but the performance does not become disorganized as in the straight up-and-down dance. A variation in this lateral dance consists of an instantaneous about-face change of direction, for a while both birds facing to the right, for example, instead of to the left. The dance ends suddenly and the birds float "butterfly-like" to the sidelines.

IMMATURE MALES

The immature male resembles the plain olive-green female but is easily distinguished by his crown which is red, as in the adult male. Young birds change gradually into the striking plumage of the adult, and their middle tail feathers may be just as long. The blue color of the back develops last of all.

I have seen immature males dancing with each other exactly like the adults, but I never happened to find a mixed partnership between a young male and an adult male. Nor did I ever see a young male make the "butterfly-like" flights of the adult.

Whenever I watched the adult male's antics my attention was invariably attracted by his blue back. In the case of the young male, soberly colored and lacking a blue back, it was the red crown which drew my eye. It is curious that in another manakin, the White-throated (*Corapipo leucorrhoa*), in which the young male resembles the female and the adult male is strikingly clad, the young male also engages in a courtship performance, as does the Long-tailed, apparently only with other young males. In both species the young male seems to display one part of his plumage and the adult another.

THE ROLE OF THE FEMALE

During the floating flights of the males, in no instance did I happen to locate a female. It is quite possible that one may have been present but that I simply did not see her. During the dances of the males I have seen a female only occasionally, but one may have been perched close by at other times, too, without my being aware of her presence.

Every female that I did see showed an eager interest in the doings of the males. Sometimes she perched in the outskirts, sometimes on the very vine or twig where the males were performing or were going to perform. If not already there, the female would apparently get so worked up by the dance that she would fly to the courtship branch. Moving sideways back and forth, or even hopping about energetically between the two males, she would often interfere with the smoothness of the performance. Unlike the birds seen by other observers, the female did not watch the proceedings passively.

SNAPPING SOUNDS

Carriker, and Dickey and van Rossem, claim that the males snap their bills, whereas Blake (1953: 329) writes that they "apparently never snap their wings audibly." Wagner makes no mention of snapping sounds. I have never heard this manakin snap its bill, snap its wings, or make any kind of snapping sound.

I wish to thank Josselyn Van Tyne in particular for his encouragement in the preparation of this paper and for his suggestions in improving the manuscript, as well as Dale Zimmerman for his comments and suggestions.

LITERATURE CITED

BLAKE, E. R. 1953. Birds of Mexico (Chicago, University of Chicago Press).

CARRIKER, M. A., JR. 1910. An annotated list of the birds of Costa Rica including Cocos Island. Ann. Carnegie Mus., **6**: 314–915.

DICKEY, D. R., and A. J. VAN ROSSEM. 1938. The birds of El Salvador. Field Mus. Nat. Hist., Zool. Ser., **23**: 1–609.

NUTTING, C. C. 1884. On a collection of birds from Nicaragua. Proc. U. S. Nat. Mus., **6**: 372–410.

WAGNER, H. 1946. Observaciones sobre el comportamiento de *Chiroxiphia linearis* durante su propagación. Anales Inst. Biol. Mex., **16** (2): 539–546.

Museum of Zoology, University of Michigan, Ann Arbor, Michigan, Michigan, December 21, 1956.

AN EMBRYOLOGICAL COMPARISON OF THE DOMESTIC FOWL AND THE RED-WINGED BLACKBIRD

BY JOSEPH CARL DANIEL, JR.

THE extensive investigations that have been carried on in the field of avian embryology have largely concerned the chicken as a representative subject. There are, however, two different general types of development among birds, namely: the nidifugous type, which results in the precocial condition at hatching, and the nidicolous type, which gives rise to the altricial condition. Various degrees and gradations of the two types are exemplified among the birds, but most embryological research has not considered the possible differences. Sutter (1950) in examining this problem stated, "Field ornithology has done much work in the domain of . . . contrasting postembryonic development of birds . . . but the comparative morphology of different types of ontogenesis is still at the beginning."

The purpose of this investigation is to compare an example of ontogeny from a precocial order (*Galliformes*) with one of an altricial order (*Passeriformes*), noting especially morphological differences of large magnitude or time discrepancies, and attempting to throw some light on the problem of why one bird hatches in about 21 days while the other requires only twelve days. Much information was readily available on the chicken (*Gallus domesticus*), so it was the logical choice to represent the first order. Among the passerines, however, very little concentrated work on any one species has been done. Consequently, I selected the Thick-billed Red-wing (*Agelaius phoeniceus fortis*) to represent this group because of the accessibility of the nests and the large number of eggs available for collection and preparation.

Prepared material of the Red-wing was compared to corresponding information on the chick as recorded in numerous sources, but mainly in Hamilton (1952), Patten (1951), and Arey (1954). Chick embryo microscope slides were also used to supplement the published material. Discussion of postembryonic development is omitted except where needed for clarification.

I wish to acknowledge the assistance of Dr. Gordon Alexander, head of the department of Biology at Colorado University, for his continued encouragement and constructive criticism.

Over a three-year period 750 Red-wing eggs were collected from ten colonies located within a twenty-mile radius of Alamosa, Colorado. Of these, only about 300 proved useful. Sterility, breakage, dead embryos, preparation errors, and partial early incubation account for the rest.

All eggs were retained in an incubator at 37° C. and at high humidity for the length of time desired. Twenty minutes were allowed for the eggs to reach incubation temperatures.

Stages were selected for preparation at every six hours of incubation for the first four days, every twelve hours for the next two days, and every 24 hours for the days thereafter. As in the chick, Red-wing embryos of the same age may be notably different from each other, so enough specimens were prepared of each age to facilitate the establishment of a norm.

Artificial incubation seemed adequate for proper development of the embryo for the period preceding the seventh day, and again beyond the seventh day to hatching; but for reasons that are poorly understood it was extremely difficult to incubate and retain the embryo alive over the seventh day. Several authorities record and discuss similar observations of critical periods for other birds (see Kendeigh, 1940, and Romanoff, 1949). In order to complete the embryo series across the seventh day, nests were marked and one egg collected from them early each morning, thereby providing a series of eggs, each one day older than the preceding one. Other eggs were incubated by the parent birds beyond the seventh day and then removed to be artificially incubated, thereby further adding to the later desired stages. A few discrepancies resulted, but because of the large number collected, most of the embryos fell easily into 24-hour categories.

After removal from the yolk, the blastoderm was supported inside paper rings according to the method described by Roudabush (1942). Larger embryos (above 96 hours) were removed from the yolk and handled directly without use of the paper rings. Since the small size and delicacy of the yolk in an egg this small resulted in the destruction of a high proportion of the blastoderms, I devised a hot ring technique to simplify the removal process (Daniel, 1955).

Preparations of the whole mounts and sections were carried out according to standard techniques. Specimens were variously stained with hematein, Grenacher's borax carmine, and Delafield's hematoxylin. Rings cut from xylol-insoluble plastic tubing (Tygon-S-22) were used as mounting cells for embryos older than four days.

Whole embryos and serial transverse sections were made of all stages described up to eight days of development and sagittal sections were also made of a few stages where better understanding of the subject made them desirable (24, 96, and 144 hours). Sections were cut at fifteen microns. It was not practical to prepare serial sections of embryos above eight days of development. Embryos from this stage to hatching were studied by dissection, with some of the organs

sectioned for a more detailed observation. Blood smears were also made of these later stages.

Several special preparations were made of six- to twelve-day-old embryos, including a series for bone development stained with alizarin, a series for cartilage development using the Lundvall technique with methylene blue, and a series of circulatory injections with India ink.

RESULTS AND DISCUSSION

Incubation Time.—From observations made on partially incubated eggs, it can be concluded that natural incubation may start with any egg of the Red-wing clutch, but usually does so with the third one to be laid. The natural incubation time of the Red-wing is generally quoted as being eleven to twelve days (Nice, 1953). Under the artificial conditions employed in the present study, the Red-wing requires a twelve- to twelve-and-one-half-day incubation period. This slight discrepancy between natural and artificial incubation times has been observed, discussed, and satisfactorily accounted for by Graber (1955), Huggins (1941), and Kendeigh (1955).

The nine-day difference in incubation time between the Red-wing and the chicken is less easily accounted for. Differences in egg size, period of retention of the ova by the adult, optimum humidity, and individual metabolism have been used to account partially for this. The most significant contribution, however, is that of Kendeigh (1940), who presented a scale to measure the increase or decrease in the incubation time that changes in temperature can cause. Employing this scale to the 2.9° difference (Huggins, 1941) found between the incubation temperature of the chicken and that of the Red-wing, we may expect a three-and-one-half day incubation time difference on this basis alone. Morphological and physiological differences must account for the remainder.

The Egg.—Differences in the egg structure between the two birds reflect incubation time differences. In reference to data from Asmundson *et al.* (1943), it will be noted that the percentage of yolk is decidedly lower and that of albumen higher in the chicken than in the Red-wing. This is to be expected since the yolk is consumed more rapidly the larger the embryo becomes; hence proportionally less would be needed for a twelve-day growing period than for a 21-day growing period, if growth rate is roughly comparable. This can be illustrated in the Red-wing by noting that the average yolk weight at laying is 0.8 grams, at eight days of incubation 0.64 grams, at ten days 0.42 grams, and disappears by hatching time at twelve days. The difference in yolk size is partially due to the presence of fewer concentric layers of yellow

yolk in the Red-wing egg than in that of the chicken, but the diameters of these layers are also relatively smaller in the Red-wing.

The Blastoderm.—In the chicken the blastoderm, at laying, averages about 3.5 mm. in diameter, but in the Red-wing, only 2 mm. in diameter. Because of differences in the size of the yolk, the curvature of the Red-wing blastoderm (0.20) is four times greater than that of the chick blastoderm (0.05), even though the arcs described by them are almost equal (12° and 10° respectively). The relative position of the blastoderm on the yolk appears to be the same, since the angles between the embryonic axis and the principal egg axis vary from 45° to 125° in passerines (sparrows) and about 45° to 135° in chick embryos (Bartelmez, 1918). Dehnel (1928), in observations of ten- to thirty-hour-old embryos of 32 species of birds, found that he could divide them into two distinct types (i.e., nidifugous and nidicolous) on the basis of their early blastoderm characteristics.

Body Form.—In general, the gross morphology of the chicken and Red-wing embryo is much alike in all stages up to the hatching date of twelve days for the Red-wing. A few minor differences may be noted: the eyes are relatively larger in the chick than in the Red-wing; the beak of the Red-wing is slightly larger near hatching than that of the chick; the Red-wing possesses the egg tooth anlage on the lower jaw as described by Ludicke (1933), whereas the chick does not; and the feathers of the eleven- to twelve-day Red-wing are better developed and larger than in the chick of the same age.

In addition to the minor superficial differences noted above, a consistent difference in size persists throughout, as would be expected because of the size difference both in the eggs and in the parent birds.

Age	*Red-wing*	*Chick*
0 hours	2 mm.	3.5 mm.
24 hours	3.5 mm.	5 mm.
48 hours	5.5 mm.	7 mm.
72 hours	5.5 mm.	7 mm.
96 hours	6 mm.	7.5 mm.
5 days	7 mm.	12 mm.
6 days	9 mm.	15 mm.
7 days	11 mm.	17 mm.
8 days	14 mm.	21 mm.
9 days	19 mm.	23 mm.
10 days	21 mm.	31 mm.
11 days	30 mm.	37 mm.
12 days	35 mm.	46 mm.

A listing of approximate maximum lengths of the two embryos for daily timed stages makes this difference apparent.

Plotting these measurements against the age of the embryo will give us rough relative growth curves (Figure 1). The growth curves are

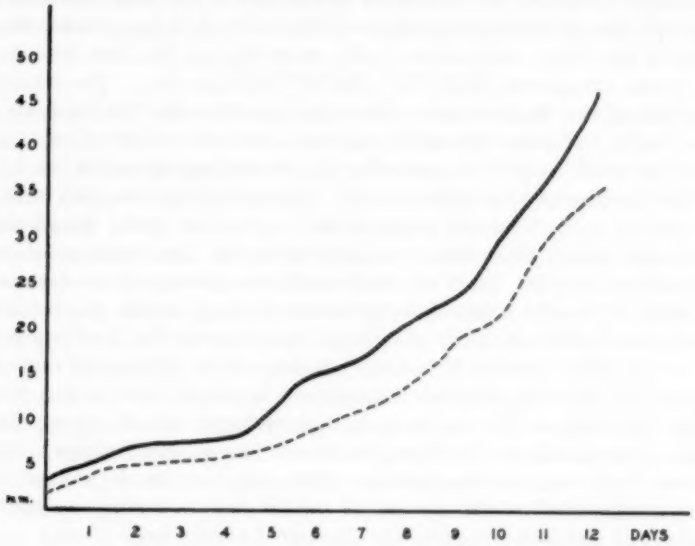


FIGURE 1. Growth curve of the chick (solid line) as compared to that of the redwing (broken line).

Age (*in hours*)	*Number of Somites*	
	Chicken	*Red-wing*
24	1	1
30	7	8
36	10	12
42	13	14
48	17	17
54	27	25
60	30	28
66	33	32
72	36	35
78	41	40
84	44	42
96	To tip of tail	

very similar and possibly would be parallel if body length would lend itself to more accurate measurement. The "plateau" in growth rate, present between the second and fourth day in both birds, is the result of extreme flexion increase of both head and tail. Therefore, body lengths are not comparable directly to other periods.

The average number of somites at any given age is very nearly equal in the two birds. A variation of one or two is observed in most cases but the normal range within a single species is usually as great.

The final number of somites in the chick may be about six more than in the Red-wing; this would account for the larger number of vertebrae in this bird. The observation on somite numbers corresponds closely to the data described earlier on relative growth.

Embryonic Membranes.—The general mode of development of the extraembryonic membranes is similar in the two birds, but a few minor differences occur. Trossarelli (1930) described a vitelline caecal diverticulum, which represents the remains of the vitelline canal, coming off the ileum of the chicken. In the chicken it may persist into adulthood, but in the passerines it is completely absorbed at the beginning of post-embryonic life. The yolk sac umbilicus, which closes in the chick about four days before hatching, appears not to close until after retraction in the redwing. Relatively speaking, the allantois develops more slowly and to a less definitive degree in the Red-wing than it does in the chick.

Nervous System.—Vaugien (1949) said, "The only important difference between the nidifugous and nidicolous birds is to be found in the relative growth of the brain and the optic lobes." Between the Red-wing and the chick many morphological differences appear, but without a doubt the nervous system is the seat of the greatest developmental discrepancies. The first such discrepancy appears with the closure of the neural groove. In the Red-wing the closing process starts in the anterior end and works mainly backward, whereas in the chick it starts farther back and works both ways. Holmdahl (1928), working with Starlings, made the same observation as noted for the Red-wing. He further noted that closure is complete at an early stage in the chick except for the temporary persistence of the anterior neuropore, and perhaps one other secondary neuropore, whereas in the Starling, it closes sporadically so that as many as seven neuropores may be observed along the length of the neural tube. Gogl (1930) describes three consistent neuropores in canaries. In the present study five such neuropores can be distinguished in the Red-wing by following serial sections and India ink injections.

Sutter (1950) has prepared some interesting charts on the relative

wet and dry weights ("dry weight is in close relation to myelinization") of the hemispheres, the corpora bigemina, the cerebellum and the stem remnant (i.e., the medulla oblongata and the basal parts of the mesencephalon and diencephalon) to show differences of development. He found that the galliform brain represents forty per cent of the adult weight at hatching while the passerine brain represents only ten per cent of the adult weight at hatching. In general, at any given age the brains of the two birds are approximately the same size. Since the chick embryo is larger than that of the Red-wing, the relative brain development is greater at any age in the nidicolous bird. In a series of studies, involving more than 219 species of birds, Portmann (1946, 1947a, 1947b) tried several possible indices of "cerebralization" with fair success. His work clearly indicates that the Passeriformes, as nidicolous birds, have relatively much better developed cerebral hemispheres and therefore more potential higher nervous control than the Galliformes, as nidifugous birds.

The optic chiasma, in the floor of the diencephalon, is a conspicuous fiber bundle after five and one half to six days of development in both birds, but one obvious difference presents itself. In the chick it is said to continue as a ridge in the lateral zones on each side up to the optic centers in the mesencephalon. In the Red-wing the optic tracts are buried immediately after decussation, in the floor and walls of the diencephalon. Here they pursue an internal course into the mesencephalon rather than a fairly superficial course as in the chick.

The epiphysial protuberance evaginates in the 72-hour chick and by seven days has elongated, branched, and shifted its point of attachment somewhat posteriorly. At 54 hours the Red-wing already exhibits this primordium, and it has reached the described point of development by six days of incubation.

The postotic ganglion in the chick completely splits into the superior ganglion of the ninth cranial nerve and the jugular ganglion of the tenth, presumably owing to the mechanical action of the formation of the third visceral cleft. In the Red-wing the two separate ganglia may be distinguished before the third cleft appears, and they do not entirely separate but remain joined by a slender connecting piece just at the point of entrance into the brain. In the chick, the hypoglossal nerve arises from two roots or bundles of axones that immediately fuse into the main nerve trunk. In the Red-wing, I find three original rootlets, the smaller two of which seem to join first before final fusion with the third.

In the chick eye, the inner and outer layers of the lenticular zone of the optic cup become actually fused together after about six days

of development. In the Red-wing, they do not fuse until at least the eighth day. Consequently the ciliary processes that begin to form in the eight-day chick do not do so until about one day later in the Red-wing. The lens epithelium, forming the annular pad that serves to transfer stress from the ciliary processes to the lens fiber, begins to thicken in the eight-day chick, but because the ciliary process is slow in forming in the Red-wing this pad does not develop until after the tenth day. The sphincter muscles of the iris arise by the eighth day in the chick, becoming more pronounced thereafter. I cannot distinguish these primordia by the time of hatching in the Red-wing, though Slonaker (1921) observed them first in the English Sparrow in the eleven-day embryo.

With the formation of the chick cornea, before and during the seventh day, the lens withdraws from the corneal surface to produce an anterior chamber that is continuous with the posterior chamber around the margins of the lens. This communicating canal is presumed to be closed in the living state of slightly older embryos. In the embryonic Red-wing, the corneal development parallels that of the chick, but the lens does not withdraw from the surface except at its periphery, because of its curvature in this zone, to produce a ring-shaped anterior chamber. This chamber is not continuous with the posterior chamber. In the English Sparrow the aqueous chamber does not separate the lens from the cornea until the thirteenth day (Slonaker, 1921).

The chick pecten develops the adult condition of seventeen to eighteen folds from the ninth to the seventeenth days of incubation, and pigment appears in it after the twelfth day. By the hatching time, the Red-wing pecten shows only a few slight folds and no pigmentation. Slonaker (1921), working with the English Sparrow, noted three folds at hatching and specified that twenty folds are present in the adult stage and that pigmentation appears after hatching, which he suspects might deposit as a result of light stimulus. In the Red-wing a thickened area of the chorioid coat that is to become the fovea appears just at hatching. In the English Sparrow it continues to thicken, accumulates a greater blood supply, and develops a pit in the thinner center (Slonaker, 1921). The postembryonic development of the Red-wing is outside the scope of this paper, but foveal development in this bird is presumed to parallel that in the English Sparrow. The chicken has no fovea.

The eyelids arise at about the same time in both birds, but the smaller eye of the Red-wing permits them to reach their definitive condition earlier than in the larger-eyed chick. In the nine-day

Red-wing the conjunctival papillae are almost entirely covered by the eyelids, a condition that is not reached until about eleven days in the chick.

Hamilton (1952) states that in the ear of the chick, "the paratympanic organ is a small ovoid vesicle . . . lined with a simple cuboidal epithelium except on the medial walls where there is a thickened ridge containing sensory cells." The paratympanic organ in the Red-wing is relatively larger than that of the chick, and thickened, interspersed, columnar cells, which might all be sensory, form an epithelium lining the entire vesicle. Since this organ is believed to be baresthetic in function, it appears that the Red-wing might be more sensitive to altitude than the chick.

Digestive System.—In an attempt to show structural organogenesis in relation to total body weight, Portmann (1947b) concluded that the entire digestive tract and the liver, in respect to weight, are relatively much better developed in the passerine embryos than in the galliform embryos. Most of my observations support this conclusion, and it might be further noted that the anlage of the digestive tract appears in the Red-wing some six to twelve hours earlier than in the chick.

The mouth in general is alike in both birds except for the development of a slightly longer beak in the Red-wing. Tongue development is basically the same in all birds, as pointed out in the meticulously detailed account by Kallius (1905), but differences in shape do occur, usually reflecting differences in food habits.

In the chick four visceral pouches are known to form, and Hamilton (1952) cited several other references suggesting that five, six, and even seven pouches could possibly be accounted for, but that anything beyond four is questionable. Sections through a 72-hour Red-wing embryo show very clearly that five pouches do develop in this bird and that a sixth one makes a rudimentary appearance. This supports Kallius (1905) in his observation of a well-developed fifth visceral pouch in English Sparrows. The sixth pouch seems to be the same as the debatable postbranchial body in the chick.

In the chick the lumen of the esophagus becomes occluded at its cephalic end by proliferation of the lining cells. Fluid vesicles appear in it on the ninth and tenth days; and by fusion, they eventually restore the lumen by the eleventh day. The Red-wing shows the same occlusion, but it appears one day earlier and the lumen is reopened by the ninth day. The esophageal glands appear in the chick at sixteen days of incubation and are fully formed by the nineteenth day. These same glands may be seen in their final condition by the time of hatching in the Red-wing.

The crop is well developed by the eighth day in the chick embryo, but a distinct crop never appears in the Red-wing. Stomach development is very similar in both birds, except possibly for a slight chronological difference in the appearance of the tubular glands of the gizzard. They form at about the thirteenth or fourteenth day in the chick, becoming functional at seventeen and one half days. The hatchling Red-wing shows these glands well formed and presumably functioning because the lining of the gizzard, which is the hardened secretion of these glands, is already present at this time.

The convolutions of the small intestine that lie in the umbilical cord are retracted into the abdominal cavity on the seventeenth to eighteenth day in the chick, three and one half to four days before hatching. In the Red-wing they are retracted on the eleventh day, immediately before hatching. In the chicken at hatching, the intestine is arranged in four longitudinal loops with the ileum exhibiting a few secondary coils. The Red-wing at hatching appears to have a relatively shorter intestinal tract and possesses only one major loop, with the others ill defined. The origin of the two intestinal caeca can be detected on about the seventh day in both birds. In the Red-wing they are vestigial and attain a total length of only four mm. by adulthood, while in the chicken they may become as long as 250 mm. by this time. The large intestine of the chick remains closed, up to as late as the seventeenth day, by a cellular plug which originated on the fifth or sixth day. The Red-wing also exhibits a cellular plug, but it disappears on the eleventh day.

The origin of the liver in the chick appears to be a controversial subject. Kingsbury *et al.* (1956), discuss liver development in the chick in great detail. The observations reported here parallel those made on the Red-wing, with one exception. Instead of two separate diverticula arising from the margin of the anterior intestinal portal as observed in the chick, only one diverticulum seems to appear in the Red-wing, but that one immediately (within six hours) forks into two branches. This single diverticulum might be interpreted as being the hepatic furrow and the two branches might represent the two separate diverticula noted in the chick. If this is so, the only difference would be in the relative depth of the hepatic furrow.

Respiratory System.—In the chick the parabronchi meet and fuse to form an intercommunicating network of tubes from the eleventh to the eighteenth day. It would seem necessary that this process be initiated earlier in the Red-wing so as to be completed by the twelfth day, but this appears not to be true. The Red-wing lung at hatching shows the same fusion of the parabronchi to be in progress

but not completed. We may therefore assume that the network is not completed until several days after usage has started and therefore that the early respiratory activities of the young Red-wing are relatively inefficient. The Red-wing lung seems to develop fewer primary branches of the mesobronchus than that of the chick. For example, the six-day chick exhibits ten branches, but in the six-day Red-wing only eight can be distinguished. One difference exists in the air sacs of the adults that probably originates postembryologically. The chicken exhibits two anterior thoracic air sacs, whereas the Red-wing has only one large one. Wetherbee (1951) observed the same condition in comparing the English Sparrow with the pigeon and assumed that a fusion had taken place.

Circulatory System.—Miller (1903) in investigating the development of the postcaval vein in the chick and the English Sparrow observed that the "mode of development of the two forms is found to be very similar, differing in only a few unessential points." This observation of Miller holds true for the entire circulatory system in a comparison of the Red-wing and the chick.

A few minor differences bear mentioning. The fifth aortic arch is very rudimentary in the chick and even absent in some embryos. When it is present, Hamilton (1952) describes it as "a slender vessel passing from near the base to near the summit of the sixth arch." In the Red-wing, the fifth arch is much better developed and passes unattended from the ventral aorta to the dorsal aorta without communicating with the sixth arch, except possibly just at the points of contact with the two aortae.

The ductus arteriosus and the foramina in the interatrial septum do not close in the chick until a short while after hatching. Red-wing specimens taken within two hours after hatching do not exhibit any foramina in the interatrial septum, and it is therefore assumed that they close just at or before hatching and that the ductus arteriosus has also closed in order to establish pulmonary circulation. The efficiency of the incompletely developed lungs would be improved somewhat by a well-formed pulmonary circulation at this time.

The omphalomesenteric vessels enter the embryonic Red-wing body farther cephalad than they do in the chick. Somite 22 marks the point of entrance in the chick, but in the Red-wing they enter at about the level of the nineteenth somite.

Witschi (1935) noted that the mesenteric arteries come off the dorsal aorta at the level of the twentieth somite in the Red-wing and the twenty-second one in the chick.

Sandreuter (1951) prepared an extensive comparative account

of blood components and blood-forming tissues on numerous birds. He found no major differences in the blood itself, but found striking differences in the hemopoiesis of the different species. He concluded that there is a more efficient type of erythrocyte in the species with the higher degree of cerebralization. Smaller birds, in general, have a higher erythrocyte number and smaller size than larger birds.

Excretory System.—The solid sprout that forms the pronephric tubule arises from the intermediate cell mass halfway between the somite and the lateral plate and projects dorso-laterally in the chick. Later, as the coelomic cavity enlarges to divide the definitive somatic layer from the splanchnic layer, the pronephric anlage becomes secondarily attached to the somatic layer. In the Red-wing this sprout seems to arise directly from the point of junction of the somatic mesoderm with the intermediate cell mass and is therefore primarily attached to the coelomic roof layer. From the point of attachment it projects dorsomedially. This slight difference in orientation of the pronephric anlage may account for the condition of the pronephric glomeruli somewhat later. In the chick, glomeruli develop transitionally in relation to the posterior pronephric tubules. They are well imbedded in the mesoderm of the area and are poorly suggested at best. The same glomeruli in the Red-wing appear as if contained within distinct bulbous bodies that project into the body cavity, and vascular connections may be traced to both the dorsal aorta and the post-cardinal veins. The projected position conveniently places the glomerulus closer to the nephrostome of the Red-wing's pronephric tubule.

Stampfli (1950), in his comparative investigations of mesonephric kidney growth in eleven different birds, was able to distinguish four distinct periods or quarters of development. His observations show that the mesonephros of the Passeriformes differs from that of the Galliformes in time of development but apparently not morphologically. In adult passerines the glomeruli of the metanephros number about 30,000 and in the adult chicken about 200,000 (Benoit, 1950).

Reproductive System.—Witschi (1933, 1935) has investigated the asymmetry in the avian reproductive system, comparing the chick, Red-wing, and English Sparrow, and in so doing has already noted the major differences between precocial and altricial birds. Other minor differences, especially in tubule formation, have been reported by Kummerlöwe (1930). The development of the reproductive system in the Red-wing essentially parallels that in the other passerines that were investigated by these authors.

Endocrine System.—Considering all of the endocrine glands as a

unit, no major points of difference in the Red-wing and the chick can be detected in their embryology. All the glands, except the interstitial cells of the gonads that do not mature until after hatching, are developed and functioning by the twelfth to the thirteenth day in both types of birds.

Skeletal System.—Most of the differences in the skeletal development of the Red-wing and that of the chick are chronological. The major ones may best be described by listing them as follows:

	Chicken	*Red-wing*
Scapula and coracoid begin ossification	12th day	9th day
Furcula forming from fusion of rods	12th–13th day	10th day
Ischium and ilium united by cartilage	about 10th day	after hatching (post-embryonic)
Femur begins to ossify	9th day	7th day
Fibula begins to ossify	13th day	11th day
Patella begins to ossify	12th day	after hatching (post-embryonic)
Notochord contacts hypophysis	52 hours (Adelmann, 1926)	36 hours
Presumptive sternal plates appear	4th day (Fell, 1939)	6th day

Other differences of a morphological nature exist. The preacetabular process is larger and better ossified in the Red-wing than it is in the chick. The first digit of the foot is quite short in the chick but in the Red-wing is larger than the other three. This condition is retained in the adult and is an adaptation to a perching habit. Skull development is very much the same in all birds as is the lower jaw development, since they differ only in relative size and proportion according to species.

The ossification of the vertebrae takes place in anteroposterior order in the chick. In the Red-wing the process is initiated in the region between the sixth and tenth cervical vertebrae and proceeds both anteriorly and posteriorly from this point. Cocchi (1944) noted that in the Starling, vertebral ossification may begin as far back as the pelvic girdle and continue in both directions, which suggests that there is no fixed point at which it must occur. Forty-four

vertebrae appear in the chicken, but I can distinguish only about 37 in the Red-wing, the differences being located in the lumbar, sacral, and caudal region. Extensive coalescence in these areas makes it difficult to pinpoint the differences. The cervical and thoracic vertebrae appear to be equal in number in both birds.

In the chick, Hamilton (1952) notes, "the sternum ossifies from five centers, a median anterior center and paired centers in the anterolateral and abdominal processes." Dissection of seven- to eight-day nestling Red-wings suggests that only two such centers in the sternum are present, one in the anterior end of each original sternal plate. The ossification then spreads posteriorly, laterally, and into the keel. The thoracic ribs of the chick chondrify and ossify at two different centers, one vertebral and one sternal. In the Red-wing I find two such centers of chondrification, but can distinguish only a single (vertebral) center of ossification.

Cocchi (1944), in comparing the Starling and the hen, noted that only the femur, tibia, and fibula were completely ossified in the Starling by hatching time, whereas almost the entire skeleton of the chick was ossified by hatching time. The difference in incubation time, of course, accounts for these observations.

Muscular System.—By the time of hatching, the Red-wing muscles seem to be in about the same stage of development as those of the twelve-day chick embryo. The spinalis and biventer muscles, used to extend the head and neck, may be heavier in the Red-wing at this stage. This condition is possibly correlated with their use in breaking the shell. Young Red-wings also extend the head and neck when demanding food, so the heavier development of these muscles may further be accounted for by their immediate need in food-getting. It is known that the vocal membranes in the syrinx of oscine birds are controlled by five to seven pairs of muscles, while the suboscines exhibit less than five. This difference between the chick and Red-wing cannot be detected embryologically.

Integumentary System.—The skin and its derivatives show few major points of variation between the chick and the Red-wing. Scale outlines first appear on the leg in the eleven-day incubated chick. They may first be detected as early as the ninth day in the Red-wing. Down feathers cover the entire chick at hatching, having first appeared as early as the eighth day and being fairly well distributed over the body by twelve to thirteen days. Growth ceases abruptly on the thirteenth day and only cornification takes place thereafter. In the Red-wing feathers arise at the same time but remain sparse until a day or two after hatching. See Willier and Rawles (1940)

for a comparison of feather pigment development in the chick and the Robin. The primordium of the spur is discernible in the chick embryo at ten days of incubation. The Red-wing adult does not possess a spur and it does not appear in the embryo, except possibly as a slight dermal swelling. Similarly, the comb and wattles may be seen in chick embryos of about eleven days, with a dense vascular network in the underlying dermis providing the red color. Neither of these structures develops in the Red-wing. A somewhat denser vascular network is apparent in these areas in the Red-wing of eight to nine days of incubation, but it is not obvious thereafter.

Weber (1950), studying the skin in twenty different birds (including seven passerines), observed that the epidermis is divisible into distinct layers or "phases." The time of fusion and cornification of these layers differs between the nidicolous birds and the nidifugous ones.

The egg tooth (callosity) begins to form on the seventh day in both the Red-wing and the chick. In the chick it begins to cornify on the tenth day and is completely formed by the fourteenth day, at which time the gradual cornification of the jaws begins. The Red-wing initiates cornification of the tooth on the ninth day and has completed its formation at about eleven and one half days of incubation. The jaws begin to cornify on the tenth day of incubation and are relatively well cornified by the hatching date of the Red-wing, two days before they start the process in the chicken.

CONCLUSIONS

The subtle differences in developmental anatomy that have been described in the chicken embryo and the Red-wing embryo do not lend themselves to the drawing of clear-cut conclusions. Most of these differences are chronological, interpretive, or a function of general body size. As has been noted, the chicken requires 21 days of incubation and the Red-wing only twelve days. It is interesting, however, that most of the conditions (both morphological and physiological) that are present at the time of hatching in the Red-wing, and presumably necessary for that phenomenon to occur, are also present in the chick embryo of twelve to thirteen days of incubation. The reader may assume that conditions not described are very similar in the two species. Willier (1954), concerning himself with the physiological phases of embryonic development, concluded that most functional integration in the chick occurs between the tenth and thirteenth days, though functional maturation may continue even postembryonically.

The nidicolous birds, arising later in the avian evolutionary sequence,

could have evolved a twelve- to thirteen-day incubation period, because the ancestral nidifugous forms were in essentially hatchable condition at that age. There, the opportunity existed to select the shorter incubation time from the longer. If these birds were not in potentially hatchable condition, it would be difficult to infer a natural selection because a choice would not be present. This reasoning makes it unlikely that any bird could have an incubation period of *much* less than twelve days, without necessitating extensive embryological changes. Nice (1953), in discussing the question of presumed ten-day incubation periods, discounted their likelihood, and observed that eleven days is the shortest probable time and that even eleven days is quite rare. Friedmann (1927) attempted to show a ten-day period in cowbirds, but except for this he notes that "no case is known in nature where an adaptive acceleration of the rate of embryonic development seems to have accompanied the evolution of new species within a group."

Actually the Red-wing never undergoes a stage exactly comparable to that of the hatchling chick. It is interesting, however, that the young bird leaves the nest at ten days, able to hop and learn to hunt for its food (Nice, 1950). The twelve days of incubation plus the ten days as a nestling total 22 days, almost the exact time needed for incubation of the chick to a similar condition. The differences between the precocial and altricial birds seem to lie in the time of their retention within the protective shell and therefore may possibly be a function of yolk size.

The reader is referred to the work on the postembryonic brain by Sutter (1950) for other interesting conclusions that concern the same problem investigated in the present paper.

SUMMARY

Over 750 eggs of the Red-wing were collected during a three-year period and the embryos prepared in diverse ways for the study of particular structures. Observations on the Red-wing were then compared with those in the literature on the chicken.

Many differences are recorded in incubation practices, egg structure, blastoderm, general body form, embryonic membranes, and most body systems. Essentially both birds are equally well developed, both morphologically and physiologically, except possibly in the nervous and digestive systems, by twelve to thirteen days of incubation. Many of the observed differences are readily correlated with different life habits, feeding, and earlier hatching in the Red-wing. Some of these differences are at the species, or even individual, level, and are not as significant as order differences.

Nevertheless, the equality of development made possible the evolution of altricial birds from precocial ones, by giving the opportunity to select the short incubation type.

An incubation time of much less than twelve days appears to be unlikely.

It is noted that incubation may start with any egg of the Red-wing, but usually does so with the third egg. The seventh day seems to be a critical period in development and it is difficult to incubate artificially over this time.

LITERATURE CITED

ADELMANN, H. B. 1926. The development of the premandibular head cavities and the relations of the anterior end of the notochord in the chick and robin. Journ. Morph. and Physiol., **42**: 371–439.

AREY, L. B. 1954. Developmental anatomy. 6th ed. Philadelphia, W. B. Saunders Co., 680 pp.

ASMUNDSON, V. S., G. A. BAKER, and J. T. EMLEN. 1943. Certain relations between the parts of birds' eggs. Auk, **60**: 34–44.

BARTELMEZ, G. W. 1918. The relation of the embryo to the principal axis of symmetry in the bird's egg. Biol. Bull., **35**: 319–361.

BENOIT, J. 1950. Traité de Zoologie, edited by P. P. Grassé. Tome XV: Oiseaux. Paris, Masson and Co., 344 pp.

COCCHI, U. 1944. Die Ossifikation des Skelettes beim Star und Mauersegler und deren Beziehung zur Frage des Unterscheides zwischen Nestflüchter und Nesthocher. Vierteljahrsschr. Naturforsch. Ges., Zürich, **89**: 122–133.

DANIEL, J. C. 1955. A simplified method for the preparation of avian embryos. Turtox News, **33**: 142–143.

DEHNEL, G. 1928. Sur deux types differents du développement primaire des oiseaux. Compt. Rend. Soc. Biol., **99**: 1694–1696.

FELL, H. B. 1939. The origin and developmental mechanics of the avian sternum. Phil. Trans. Roy. Soc. London, Ser. B, **229**: 407–464.

FRIEDMANN, H. 1927. A case of apparently adaptive acceleration of embryonic growth rate in birds. Biol. Bull., **53**: 343–345.

GOGL, H. 1930. Der secundäre und tertiäre hintere Neuroporus beim Kanarienvogel. Jahrb. Morph. u. Mikrosk. Anat., Abt. 2, Zeitschr. Mikrosk-Anat. Forsch., **23** (½): 227–235.

GRABER, R. R. 1955. Artificial incubation of some non-galliform eggs. Wilson Bull., **67**: 100–109.

HAMILTON, H. L. 1952. Lillie's development of the chick. 3rd. ed. New York, Henry Holt and Co., 624 pp.

HOLMDAHL, D. E. 1928. Die Entstehung und weitere Entwicklung der Neuralleiste (Ganglienleiste) bei Vögeln und Säugetieren. Jahrb. Morph. u. Mikroskop. Anat., Abt. 2, Zeitschr. Mikroskop-Anat. Foresch., **14** (½): 99–298.

HUGGINS, R. A. 1941. Egg temperatures of wild birds under natural conditions. Ecology, **22**: 148–157.

KALLIUS, E. 1905. Beiträge zur Entwicklung der Zunge. II Teil: Vogel (*Anas bochas* L.) (*Passer domesticus* L.) Anat. Hefte (Abt. I), **28**: 311–586.

KENDEIGH, S. C. 1940. Factors affecting length of incubation. Auk, **57**: 499–513.

KENDEIGH, S. C. 1955. Effect of energy resources on egg characteristics of wild birds. Paper presented before the Amer. Soc. of Zool. at A. I. B. S. meeting in East Lansing, Mich.

KINGSBURY, J. W., M. ALEXANDERSON, and E. S. KORNSTEIN. 1956. The development of the liver in the chick. Anat. Rec., **124:** 165–188.

KUMMERLÖWE, H. 1930–31. Vergleichende Untersuchungen über das Gonadensystem weiblicher Vögel. Mit besonderer Berücksichtigung der Persistierens von rechtsseitigen Keimgewebselementen im normalen Weibchen. II *Passer domesticus* L. III Ausgewählte Beispiele aus verschiedenen Vogelordnungen. Jahrb. Morph. u. Mikrosk. Anat., Abt. 2, Zeitschr. Mikrosk-Anat. Forsch., **22:** 259–413, **24:** 455–631.

LÜDICKE, M. 1933. Wachstum und Abnutzung des Vogelschnabels. Zool. Jahrb., Abt. Anat. u. Ont., **57:** 465–533.

MILLER, A. M. 1903. The development of the postcaval vein in birds. Amer. Journ. of Anat., **2:** 283–298.

NICE, M. M. 1950. Development of a redwing (*Agelaius phoeniceus*). Wilson Bull., **62:** 87–93.

NICE, M. M. 1953. The question of ten-day incubation periods. Wilson Bull., **65:** 81–93.

PATTEN, B. M. 1951. Early embryology of the chick. 4th ed. Philadelphia, Blakiston Co., 244 pp.

PORTMANN, A. 1946. Études sur la cérébralisation chez les oiseaux. I. Alauda, **14:** 1–20.

PORTMANN, A. 1947a. Études sur la cérébralisation chez les oiseaux. II. Les indices intra-cérébraux. Alauda, **15:** 1–15.

PORTMANN, A. 1947b. Études sur la cérébralisation chez les oiseaux. III. Cérébralisation et mode ontogénétique. Alauda, **15:** 161–171.

ROMANOFF, A. L. 1949. Critical periods and causes of death in avian embryonic development. Auk, **66:** 264–270.

ROUDABUSH, R. L. 1942. Embryological technique. Ward's Natl. Sci. Bull., **15:** 98–99.

SANDREUTER, A. 1951. Vergleichende Untersuchungen über die Blutbildung in der Ontogenese von Haushuhn (*Gallus gallus* L.) und Star (*Sturnus v. vulgaris* L.). Acta Anat. (Basel), XI (Suppl. 14-lad): 1–72.

SLONAKER, J. R. 1921. The development of the eye and its accessory parts in the English Sparrow. Journ. Morph., **35:** 263–357.

STAMPFLI, H. R. 1950. Histologische Studien am Wolffschen Körper (Mesonephros) der Vögel und über seinen Umbau zu Nebenhoden und Nebernovar. Rev. Suisse Zool., **57:** 237–316.

SUTTER, E. 1950. Growth and differen'iation of the brain in nidifugous and nidicolous birds. Proceedings of the Xth International Ornithological Congress (Uppsala), 636–644.

TROSSARELLI F. 1930. Contributo alla conoscenza del diverticola vitellino dell intestino di Uccelli. Monitore Zool. Ital., **41:** 39–43.

VAUGIEN, L. 1949. Relation biométrique interspecifique dans la croissance des oiseaux. Compt. Rend. Acad. Sci. (Paris), **228:** 206–207.

WEBER, R. 1950. Transitorische Verschlüsse von Fernsinnesorganen in der Embryonal periode bei Amnioten. Rev. Suisse Zool., **57:** 19–108.

WETHERBEE, D. K. 1951. Air sacs in the English Sparrow. Auk, **68:** 242–244.

WILLIER, B. H. 1954. Phases in embryonic development. Journ. Cell. and Comp. Physiol., **43** (Suppl. 1): 307–317.

WILLIER, B. H. and M. E. RAWLES. 1940. The control of feather color pattern by melanophores grafted from one embryo to another of a different breed of fowl. Physiol. Zool., **13**: 177–199.

WITSCHI, E. 1933. Demonstrations on gonadal development in birds. Abstracts of papers presented at 31st annual meeting of Amer. Soc. of Zool. Anat. Rec., **57** (Suppl. 4): 74.

WITSCHI, E. 1935. Origin of asymmetry in reproductive system of birds. Amer. Journ. Anat., **56**: 119–141.

Division of Science and Mathematics, Adams State College of Colorado, Alamosa, Colorado, July 13, 1956.

THE ARRIVAL OF CONTINENTAL MIGRANTS IN WESTERN JAPAN

BY H. ELLIOTT MCCLURE AND MASASHI YOSHII

IN the fall of 1955 we had an opportunity to study migration along the coast of western Japan by analysis of the daily take of two commercial bird netters. The apparent effects of weather and the position of the netting sites upon the daily take are reported here.

The "wave action" of bird migration has long been recognized and referred to by many authors. Cooke (1915) and Lincoln (1939) both call attention to the fact that migrating birds appear in waves. Ornithological literature of recent years records many studies of the action of weather in producing waves of bird movements. Since 1950 the rôle of weather in migration has been under study as a joint project between the Departments of Zoology and Entomology and of Physics and Astronomy at Ohio State University (Miskimen, 1955).

Bennett (1952) in a five-year study at Chicago found that "as a general rule the big migration waves of a given species occur during a cold front period." Devlin (1954) concludes from observations over a period of several years at Philadelphia that "the hour just before nightfall was the critical time in nocturnal migration." He continues, "If at that hour the winds were calm or southerly (spring) migration could be expected. It did not seem to matter if the skies were overcast as long as it was not raining." Both Lowery (1945, 1946) and Williams (1945, 1947, 1950a, 1950b) in their discussions of Trans-Gulf of Mexico migration relate the movements of birds to weather. The effect of a large cyclonic movement on bird migration over America was analyzed by Gunn and Crocker (1951). In the present study the netting sites were along spurs of the Tateyama range east of Toyama on the west coast of Japan, about 37° N. latitude and 137° E. longitude. It is along this coast of Japan that migrants from Siberia and regions of the mainland opposite Japan first arrive. The 10,000-foot Tateyama range prevents them from passing directly inland. Instead they move south along the coast and over the low spurs of mountains that finger out from the main range into the coastal plain. Concentrated in this way, the flight offers an easy catch for netters situated on many of the ridge crests.

The two sites selected for study were nearly identical except for altitude. They were about two airline miles apart, at the crests of north-facing slopes and in low deciduous second-growth brush (height about 8 to 10 feet).

Both had been in operation each year for ten or more years during the six-week period from the middle of October to the end of November. Station A, further out on the spur, was at an altitude of about 500 feet and Station B, back and higher, was at more than 1000 feet. Observations were made from October 28 through November 7, 1955, an eleven-day period during the "middle" of migration.

The operators at both sites used the same methods. Paths were cleared along contour lines through the brush, paralleling the crest, and along these paths were stretched mist nets of several sizes and

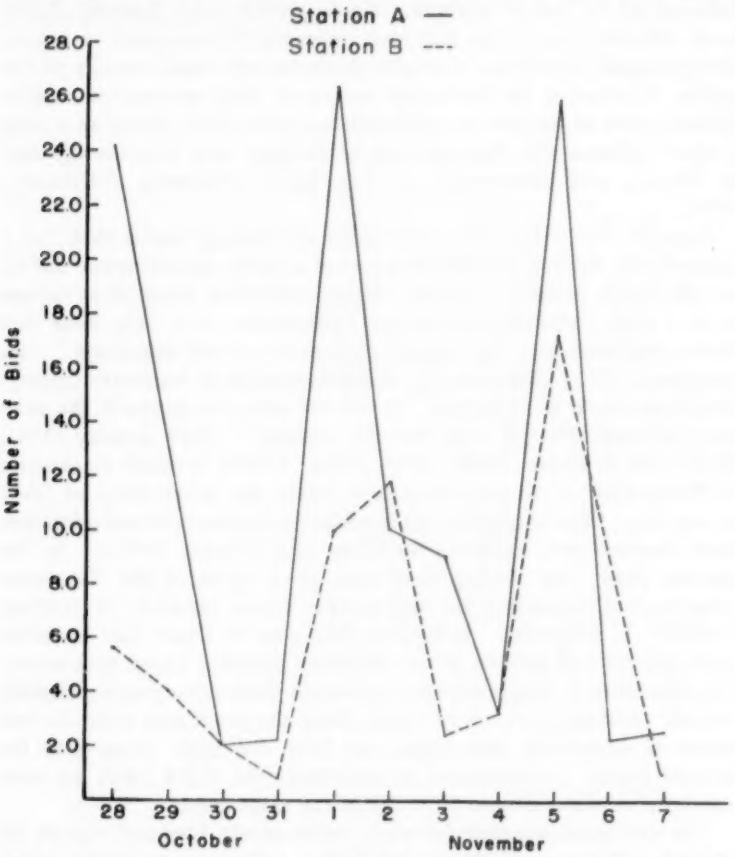


FIGURE 1. A comparison of the number of small birds, mostly fringillids, taken per net per day at two netting stations at different altitudes in Toyama, Japan, in 1955.

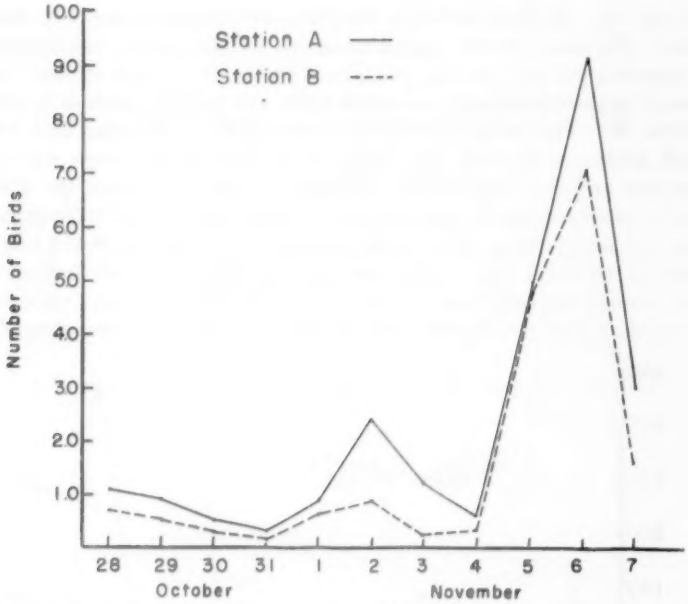


FIGURE 2. A comparison of the number of thrushes taken per net per day by two commercial netters at Toyama, Japan, during the period of observation in 1955

mesh. Living decoys of migrant species, caged and subjected to light conditions contrary to the fall diurnal rhythm so as to bring them into full song, were used to divert passing flocks into the ambush area. At site A there were 12 nets for thrushes and 24 nets for sparrow-sized birds. At site B, 40 thrush nets and 13 sparrow nets were in use. Site A had 15 thrushes for decoys and 38 smaller birds. Site B had 21 thrush decoys and 14 smaller species.

The numbers of birds captured at these two places were surprisingly different. Altitude seemed to be a very important factor. It appeared that the main bird movements were along the edge of the plains and that these paths of flight were transgressed by the low mountain spurs. The birds probably passed along the face of the mountains rather than over the open plains because the plains were under cultivation and offered less variety of food than the wooded hills. More species were traveling at a low altitude, for at Station A 30 species were netted while at the higher Station B only 11 species were taken. Ten of these were similar to those at the lower station. At Station A, 299 thrushes and 2768 smaller birds were taken during the eleven-

day period. At Station B the take was 677 thrushes and 971 small birds. Thrushes moved higher than the smaller birds; the number of thrushes per net per day was about the same at each station, but a much greater population of small birds was passing Station A than Station B. The catch at Station A averaged 2.2 thrushes and 14.8 small birds per net per day, while at Station B the catch was 1.5 thrushes and 6.8 small birds. Figures 1 and 2 compare the daily take of birds per net at each station and show that the fringillid migration was heavy before that of the thrushes. At Station B the movement of thrushes may have been greater than that at Station A, even though the catch per net was less. The take per decoy appeared to support this conclusion, but we have no way of measuring the

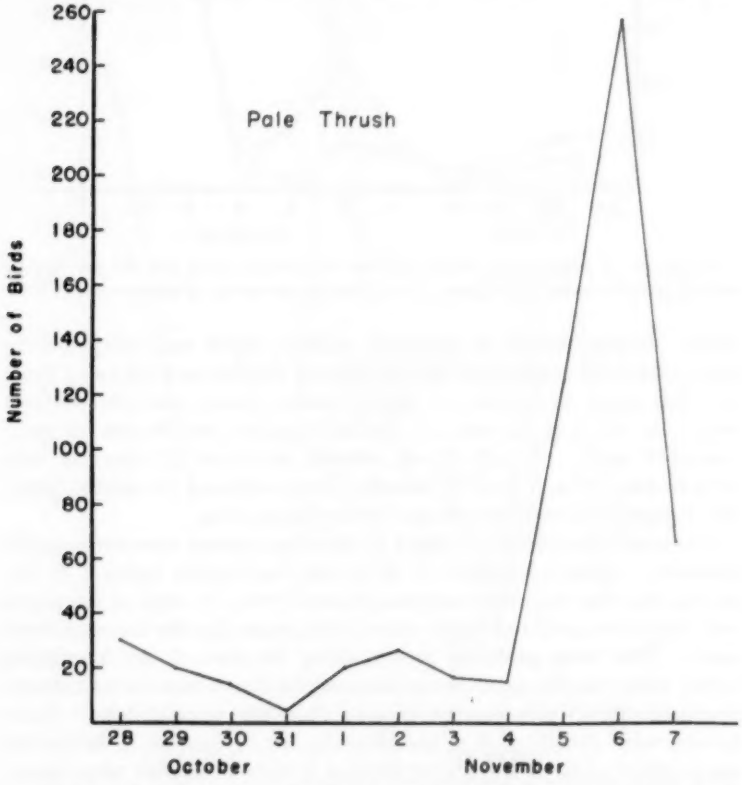


FIGURE 3. Total number of Pale Thrush (*Turdus pallidus*) caught at two netting places in Japan during the period of observation in 1955.

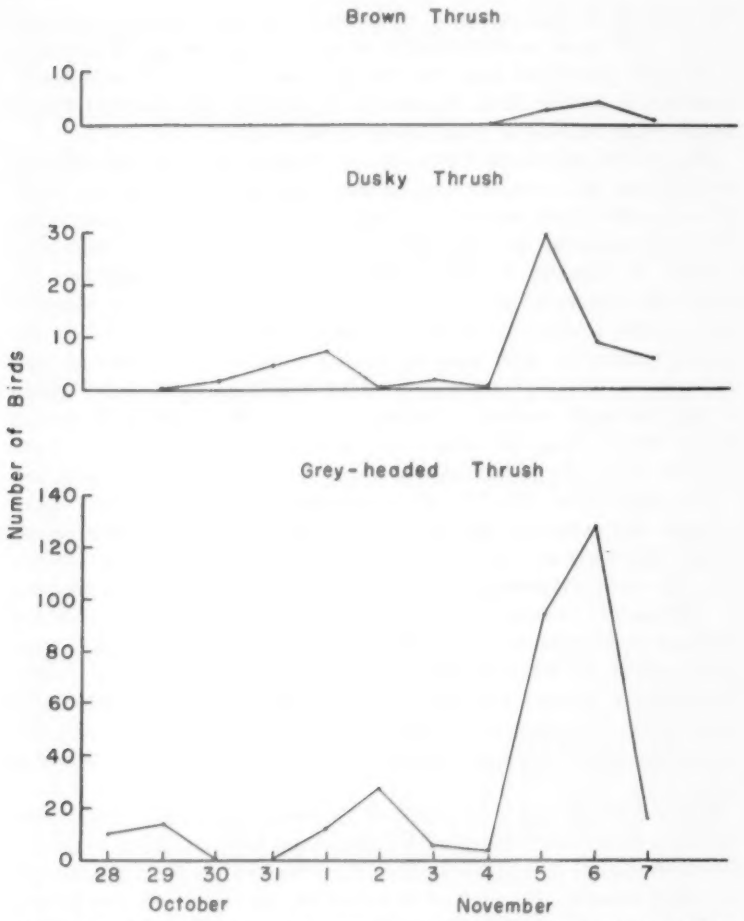


FIGURE 4. Thrushes collected by two commercial netters near Toyama, Japan, during the period of observation in 1955.

effectiveness of a given decoy. A good singer in fine health may attract more birds than several less active singers. At Station B the thrush decoys may have been more vociferous than at Station A, for the average take was 32.2 victims per decoy as compared with 20.0 per decoy at Station A. Small bird decoys were almost equally effective at the two stations; 69.3 victims per decoy were taken at Station B and 72.8 per decoy at Station A. We had no check on the

effectiveness of decoys, since there were no nets without adjacent decoys. We have no information as to what percentage of the birds would have stumbled into the nets without the decoys' enticement. However, it seemed that the success of netting was directly proportional to the number of good decoys used.

The netters complained that the daily catch was low and that the weather was the worst for netting that they had seen in many years. This was the usual netter's or trapper's complaint, for comparison with 1954 data did not support it. At Station A during the period October 26 through 30, 1954, with less rain and bad weather, the daily take averaged 241 birds. During the 1955 period of observations at this station the daily take was 273 birds. Table 1 lists the species caught at both stations during 1955 and the average take per day per decoy and per net. Migration was in flocks of mixed as well as single species. During a heavy flight, birds of several species would strike the nets. The fringillids were usually in flocks separate from the thrushes, for their flight pattern was different.

The numbers of Pale Thrush caught each day are shown in Figure 3, while the takes of Grey-headed Thrushes, Dusky Thrushes, and Brown Thrushes are shown in Figure 4. From these it is evident that the main migration movement did not begin until November 5. Although a number of Pale Thrushes had been taken each day previous to November 5, they moved in large numbers on that date, accompanied by Grey-headed Thrushes. The migration of Dusky Thrushes and Brown Thrushes had just begun when the observations were closed. Comparison with the take in 1954 shows that this movement came approximately ten days later than in the preceding year.

Figure 5 shows the daily catch of Japanese Buntings. The Rustic Bunting, Brambling, Meadow Bunting, and Grey Bunting takes are shown in Figure 6. Japanese Buntings were in greatest abundance, but all of these finches arrived in waves during the eleven-day period.

Migration and the Weather.—The netters explained the presence or absence of migrating flocks on the basis of weather. They said that a north wind was not good but that a mild south wind was favorable; that wind or rain at dawn was bad, but that cloudy weather was no detriment. In the main their observations appeared to be sound. The daily take and weather are shown in Figure 7 for 1954 and Figure 8 for 1955. During the six days of observations in 1954 there was no marked correlation between weather and take except for local weather. A wave apparently passed through on October 25, followed by decreasing numbers until October 30. Rain was

TABLE 1

THE SPECIES OF BIRDS NETTED IN TOYAMA PREFECTURE, JAPAN, FROM OCTOBER 28 THROUGH NOVEMBER 7, 1955, AT TWO SITES USING A TOTAL OF 89 NETS AND 52 DECOYS

	Species	Number decoys	Total take	Average number caught per day	Average number caught per decoy	Average number caught per net
1. Japanese Bunting	*Emberiza spodocephala*	14	2752	250.2	196.6	74.4
2. Pale Thrush	*Turdus pallidus*	11	591	53.7	53.7	11.3
3. Rustic Bunting	*Emberiza rustica*	15	428	39.0	28.5	11.6
4. Grey-headed Thrush	*Turdus obscurus*		313	28.4		6.0
5. Brambling	*Fringilla montifringilla*	9	256	23.3	28.4	6.9
6. Meadow Bunting	*Emberiza cioides*	3	99	9.0	33.0	2.7
7. Dusky Thrush	*Turdus naumanni*	25	60	5.5	2.4	1.1
8. Grey Bunting	*Emberiza variabilis*	1	24	2.2	24.0	0.7
9. White Eye	*Zosterops japonica*	3	20	1.8	6.6	0.5
10. Great Tit	*Parus major*		11			
11. Brown Thrush	*Turdus chrysolaus*		8			
12. Mugimaki Flycatcher	*Siphia mugimaki*		7			
13. Willow Warbler	*Phylloscopus borealis*		6			
14. Grosbeak	*Eophona personata*		5			
15. Grey Thrush	*Turdus cardis*		4			
16. Brown-eared Bulbul	*Ixos amaurotis*		4			
17. Varied Tit	*Parus varius*	2	4	0.4	2.0	0.08
18. Siberian Bluetail	*Erithacus cyanurus*		3			
19. Ruby Throat	*Erithacus calliope*		2			
20. Sparrow Hawk	*Accipiter virgatus*		2			
21. Bullfinch	*Pyrrhula pyrrhula*		2			
22. Willow Tit	*Parus atricapillus*		2			
23. Bush Warbler	*Horeites diphone*	2	2		1.0	
24. Brown Flycatcher	*Muscicapa latirostris*		1			
25. Siskin	*Carduelis spinus*		1			
26. Daurian Redstart	*Phoenicurus auroreus*		1			
27. Long-tailed Rose Finch	*Uragus sibiricus*		1			
28. Japanese Jay	*Garrulus glandarius*		1			
29. Green Finch	*Chloris sinica*		1			
30. Bull-headed Shrike	*Lanius bucephalus*		1			
31. Screech Owl	*Otus asio*		1			

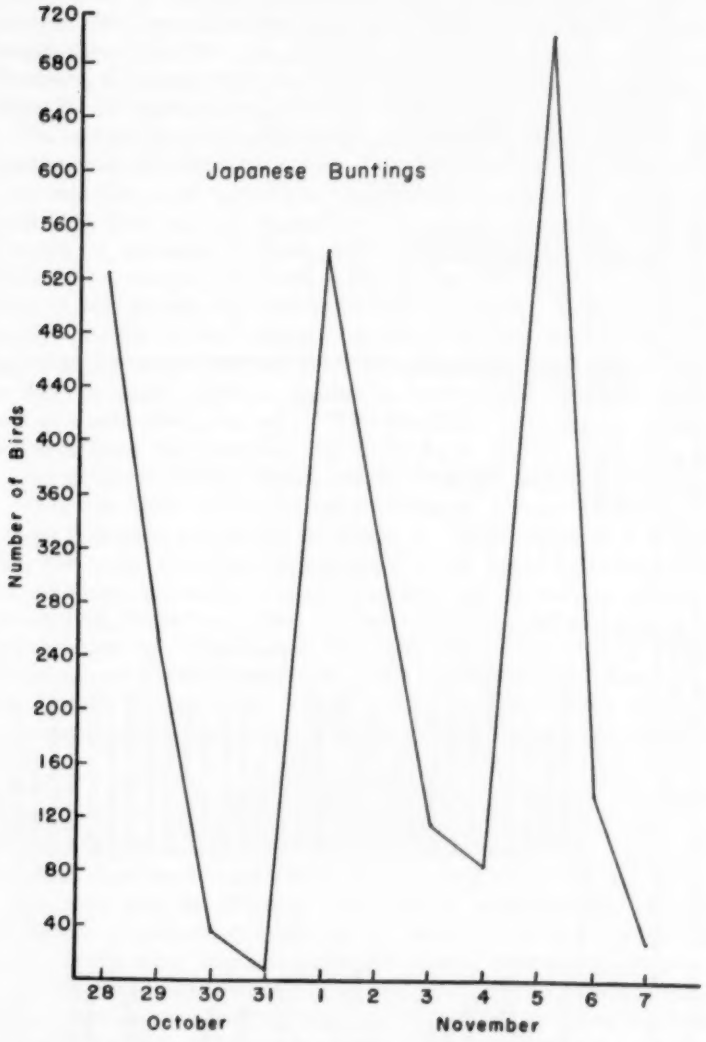


FIGURE 5. The take of Japanese Buntings (*Emberiza spodocephala*) during the period of observation in 1955.

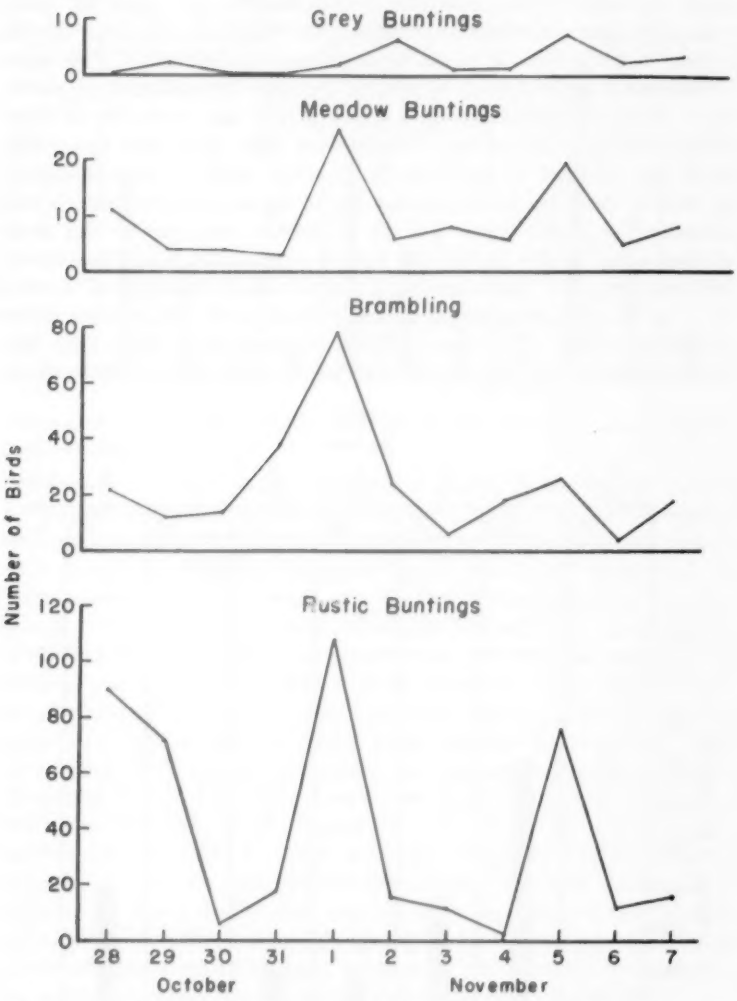


FIGURE 6. The numbers of four species of fringillids taken each day during the period of observation in 1955 at Toyama, Japan.

falling at dawn on October 29, which depressed the take to its lowest point. Devlin (1954) considered the weather at sundown more critical to migration than that during the night or at dawn. If this is true, the 1954 trend could be explained in this way. The wave of birds that arrived from Siberia on October 25 continued on south. Each evening of the following six-day period was favorable to flight except that of October 28. Winds were light and from the south, hence the weather at sundown in Toyama would in all probability be that of sundown the following day along the coast of Siberia and Kamchatka. Since there was no inhibiting weather on the coast of Siberia during this period, the flow of migrants to Japan was steady and uninterrupted, but decreasing. The rain of the night of October 28–29 at Toyama stopped migration of local birds and of birds to the immediate north of Toyama. These renewed their flight after sundown of October 29, bringing an increased take at dawn of October 30.

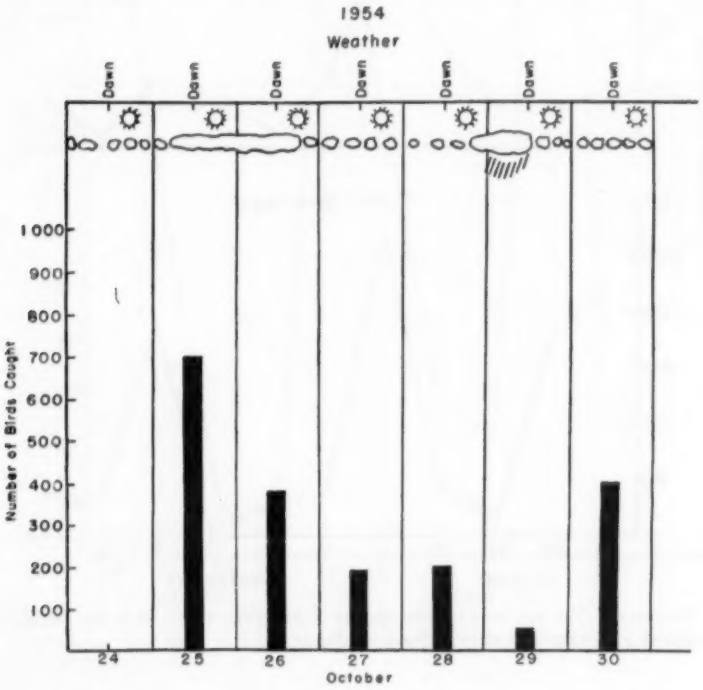


FIGURE 7. Relationship between weather and the number of birds netted at Station A, Toyama, Japan, in 1954.

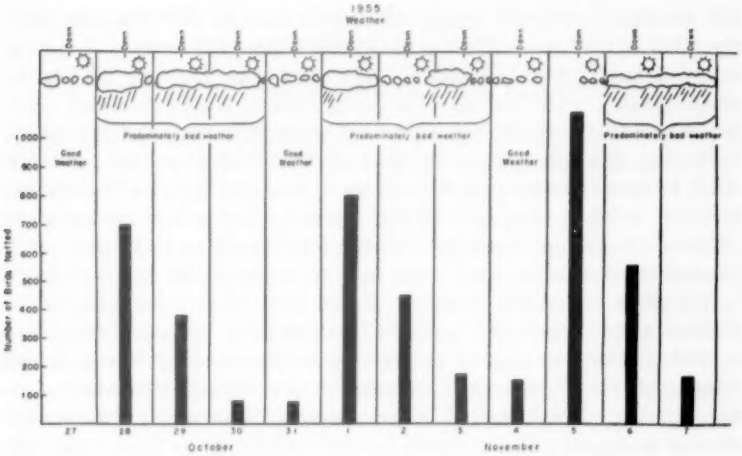


FIGURE 8. Relationship between weather and the catch of birds at Toyama, Japan, in 1955.

Since thrushes and finches migrate at night, Devlin's observations are further supported by the 1955 data (Figure 8). Here it is evident that bad weather will force the birds down and they will remain quiet until the weather improves; hence, the catch is affected by both sundown and dawn weather. During the eleven days of observation in 1955 there were three waves of migrants and three breaks in the bad weather. The cloud movement was from the south during the entire period and at no time were there heavy winds. The weather at sundown of October 26 had been clear and a wave of migrants passed on October 28. It rained until midday of October 30, with the clouds breaking at sundown. A migrant wave appeared on November 1. Bad weather at sundown again set in without a break until the afternoon of November 3. The third wave of migrants arrived on November 5. This sequence of events would appear to support the theory that favorable sundown weather occurring in Toyama 24 hours earlier and moving north approaches the Siberian coast, where it releases migrants pinned down by bad weather. This produces a wave which reaches Toyama on the morning of (or during the night preceding) the second day after the break in weather.

Summary.—During the period from October 28 to November 7, 1955, observations were made of the daily catch of commercial netters located near Toyama on the west coast of Japan. The netting sites were two miles apart on spurs of the Tateyama mountain range, which extended into the coastal plain. Both were at north-facing

hill crests in cut-over deciduous brush: one at 500 feet altitude, the other at 1000 feet. During the eleven days, 4715 birds of 31 species were netted. Most abundant were Japanese Bunting (*Emberiza spodocephala*), Pale Thrush (*Turdus pallidus*), Rustic Bunting (*Emberiza rustica*), Grey-headed Thrush (*Turdus obscurus*), and Brambling (*Fringilla montifringilla*), in that order. Observations indicated that: 1. more species passed in front of the mountains and over the crests at 500 feet than at 1000 feet altitude; 2. thrushes moved up to 1000 feet in about the same density, but fringillids and other small passerines were more than twice as abundant at the 500-foot level; 3. fringillid migration was well under way in October but turdid flights did not begin until early in November; 4. migration was often in mixed flocks and many species not represented by living decoys were captured; 5. the take appeared to be directly proportional to the number of well-trained decoys used as well as to the number of nets in operation; 6. weather at dawn affected the take, especially wind or rain, which reduced it; 7. migration took place in waves related to the weather of the Siberian coast; 8. rain or storms from the south held the birds on the mainland; and a break in weather at sundown over Toyama indicated a flight during the night of the following day and a large catch on the second morning, even though weather conditions might have become adverse again.

LITERATURE CITED

BENNETT, H. R. 1952. Fall migration of birds at Chicago. Wilson Bull., **64**: 197–220.

COOKE, W. W. 1951. Bird migration. U. S. D. A. Bull. 185.

DEVLIN, J. M. 1954. Effects of weather on nocturnal migration as seen from one observation point at Philadelphia. Wilson Bull., **66**: 93–101.

GUNN, W. W. H., and A. M. CROCKER. 1951. Analysis of unusual bird migration in North America during the storm of April 4–7, 1947. Auk, **68**: 139–163.

LINCOLN, F. C. 1939. The migration of American birds. New York, Doubleday, Doran & Co., Inc.

LOWERY, G. H. 1945. Trans-Gulf spring migration of birds and the coastal hiatus. Wilson Bull., **57**: 92–121.

LOWERY, G. H. 1946. Evidence of Trans-Gulf migration. Auk, **63**: 175–211.

MISKIMEN, MILDRED. 1955. Meteorological and social factors in autumnal migration of ducks. Condor, **57**: 179–184.

WILLIAMS, G. C. 1945. Do birds cross the Gulf of Mexico in the spring? Auk, **62**: 98–111.

WILLIAMS, G. C. 1947. Lowery on Trans-Gulf migration. Auk, **64**: 217–238.

WILLIAMS, G. C. 1950a. Weather and spring migration. Auk, **67**: 52–65.

WILLIAMS, G. C. 1950b. The nature and causes of the coastal hiatus. Wilson Bull., **62**: 175–182.

406th. Medical General Laboratory, APO 343, San Francisco, March 29, 1956.

THE RESPONSE OF CHICKS OF THE FRANKLIN'S GULL TO PARENTAL BILL-COLOR

BY ELSIE C. COLLIAS AND NICHOLAS E. COLLIAS

THE adult Franklin's Gull (*Larus pipixcan*) in the breeding season has a black head and a bright red bill with a vague dusky spot near the tip. The downy young may be fed by regurgitation of food from the mouth of the parent. The young may peck at the bill of the parent when the latter arrives at the nest and stands next to the young with bill lowered.

The purpose of our study was to see whether the *red color* of the parental bill helped stimulate the feeding responses of the downy young to the parent, as is suggested by their pecking at the bill of the parent. Tinbergen and Perdeck (Behaviour, **3**: 1–39, 1950) have reported experiments with models from which they concluded that the feeding responses of downy Herring Gull chicks are stimulated by sight of the red spot on the lower mandible of the yellow bill of the parent. This work was responsible for the initiation of our own studies.

However, instead of using presentation of hand-held models as did these authors, we have attempted to make our experimental procedure somewhat more objective by not touching the models and by usually not touching the chicks during the course of an experimental test. We also used *simultaneous* presentation of models of heads, each with a differently colored bill, instead of *successive* presentation as was done by Tinbergen and his colleagues.

Method and materials.—Each gull chick to be tested was placed in a cardboard box on one end of which there were two flat models of adult heads of the Franklin's Gull, placed so as to face each other with the bills pointing downward at an angle of about 60° and with the tips of the two bills about ½ inch apart (Figure 1). The bill of one head was red; the bill of the other head was either green or white.

Each bill was attached to a plain black head, devoid of eyes and pasted on a piece of brown paper, which in turn was fastened to a firm cardboard backing.

Each bill actually was a complex affair, consisting in the first place of a hole, cut in the shape of the bill, through the cardboard backing and brown paper on which the black heads of the models were fastened. The purpose of each bill-shaped hole was to enable us to shine a light through from behind, illuminating the bill. An ordinary goose-necked lamp was used for this purpose and was centered behind at an equal distance from each of the two bills.

Behind each bill-hole could be placed a removable panel of a given color. The color was provided by red or green cellophane. The cellophane was backed by white paper to render the transmitted illumination diffuse and translucent rather than merely transparent, as it would have been if the cellophane had been used alone. These colored panels were actually sliding panels that were inserted between the brown paper front and the cardboard backing of the set-up. Since the panels were removable, it was readily possible to switch the relative positions of red and green bills, or of red and white bills, from one test to the next, as a control over possible position effects.

A steady illumination of the bills from behind proved to have relatively weak stimulating value for the gull chicks being tested. This stimulating value was greatly increased by inserting a flasher

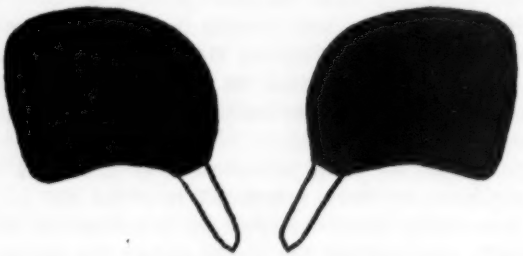


FIGURE 1. Illustration of the crude models of heads of parent gulls used in testing responses of chicks of the Franklin's Gull to bill color.

device into the light socket of the 60-watt bulb used. In this way it was possible to have both bills flash on and off together at a uniform rate of about 85 times per minute. We believe that this flashing device served as a substitute for motion of the bill in a standardized and objective way.

For support of this project we are grateful to the Delta Waterfowl Research Station, where all of this work was done. Eggs were collected from a local breeding colony of the Franklin's Gull and were hatched in an incubator at the station. This procedure assured that the chicks had not become conditioned to the sight of the red bill of the parent bird, prior to testing.

After being hatched, the gull chick to be tested was placed in the test box equidistant from, directly between, and usually about 1 to 2 inches from the models. During the test the chick was kept warm by a lamp a short distance above it and was observed from over the lamp or through a slit-like peephole in the cardboard box.

As a rule the chick was allowed from 1 to 2 minutes to become light adapted before the bills of the models were lighted from behind by the flashing lamp, signalizing the onset of the test. Later on, the procedure was altered slightly and the models were covered with a piece of cloth until after the chick had a chance to become light-adapted; the test was not timed until the chick delivered its first peck.

The number of pecks delivered by the chick on each of the two bills being compared was recorded during a period of standard length. These test periods were 3 minutes long for about the first half of the experiment and then were made one minute in length, in an attempt to maintain the motivation of the chick at a higher level. Different chicks were subjected to varying numbers of three-minute or one-minute tests.

Usually a chick was not touched by the observer during the course of a test. Occasionally a chick wandered away from the models and had to be replaced next to the models.

Results.—The first table shows the results when all of the data gathered are considered. It will be seen that 17 *individually tested*

TABLE 1

INCUBATOR-HATCHED CHICKS OF THE FRANKLIN'S GULL PECK MORE OFTEN AT A RED BILL THAN AT A GREEN OR WHITE BILL*

Comparison	*Number of chicks*	*Number of pecks*	*Probability of chance difference*
Red: green	17	3150 to 633	0.001
Red: white	18	1076 to 143	0.011

* Total time of tests per chick 6 to 18 minutes.

chicks of the Franklin's Gull, when given a simultaneous choice between models of two heads, one with a red and one with a green bill, pecked the red bill over 3000 times and the green bill only 633 times. Under similar conditions, 18 other chicks pecked the red bill over 1000 times and a white bill only 143 times. This preference of the chicks for a red bill, i.e., one of the normal color of the parental bill, was statistically significant when tested by Student's method of paired comparisons.

These chicks ranged in age from 4 hours to 4½ days when tested. If a chick was too young it was likely to go to sleep during the test; if too old, our impression was that the chick was not much attracted to flat models.

For the purpose of a more uniform comparison, the data were reclassified, and we included only the data for the first six minutes that each chick was tested. Under these conditions most of the chicks were 7 to 20 hours old when tested; only 3 of the 35 chicks tested were more than a day old.

The second table shows that 17 chicks, each individually tested for a total of 6 minutes, pecked the red bill over 2000 times and a green bill, simultaneously presented, fewer than 500 times. Under similar conditions, 18 other chicks pecked the red bill almost 900 times and a white bill, simultaneously presented, only 60 times. This preference of the gull chicks for a red bill, when each chick was tested for a total time of exactly six minutes, was statistically significant.

TABLE 2

INCUBATOR-HATCHED CHICKS OF THE FRANKLIN'S GULL PECK MORE OFTEN AT A RED BILL THAN AT A GREEN OR WHITE BILL*

Comparison	*Number of chicks*	*Number of pecks*	*Probability of chance difference*
Red: green	17	2105 to 492	0.0004
Red: white	18	895 to 60	0.0006

* Each chick was tested for a total of 6 minutes.

TABLE 3

EXAMPLE OF THE RESULTS OF SUCCESSIVE THREE-MINUTE TESTS ON TWO INDIVIDUAL CHICKS. (FRANKLIN'S GULL)

	"Yellow-head"		*"Green-head"*	
	Red	*Green*	*Red*	*White*
	85	2	92	0
	49	1	41	11
	204	7	12	9
	114	1	34	0
	86	22	38	0
	37	12		
Totals	575	45	216	20

The third table shows the records of two individual chicks, and is intended as an example of the consistency with which many chicks will peck the red bill in preference to a green or white bill during the course of successive tests. Sometimes a chick would be seen to pause in its attacks on the red bill, turn toward and apparently inspect the green or white bill, and then turn back and resume its pecking of the red bill.

The question arises as to whether the chicks were actually responding to color as such or merely to differences in relative intensity of the three colors tested. Measurements with a phototronic foot-candle meter indicated that the white bill transmitted roughly about twice as much light as did the red bill, which in turn transmitted about twice as much light as did the green bill. It follows that the apparent preference of the chicks for red could not have been due to a consistent preference for a greater or lesser intensity of light in the red bill, as compared with the green or white bill.

It seemed possible, however, that the chicks might merely prefer light of a medium intensity. But the usual variation in the distance of the rear lamp from the test panel was about 3 inches, and even this small variation resulted in about a 100 per cent variation in the amount of light transmitted by either the red, green, or white bill. The consistent preference of the gull chicks for the red bill, despite almost 100 per cent variation in the absolute intensity of light transmitted by the differently colored bills, is evidence for color preference as against selection of a certain absolute intensity of light in the red bill.

Summary and conclusions.—A new technique is described for the objective testing of the reactions of young birds to color stimuli involving the simultaneous presentation of flashing colored lights. This technique was applied to incubator-hatched chicks of the Franklin's Gull (*Larus pipixcan*). Individual chicks were exposed to two flat cardboard models of the head of the adult gull, each head having a differently colored bill. Summarizing all of the tests, we observed that the chicks pecked at a red bill (the parental bill color) 7 times as often as they pecked at a white bill and 5 times as often as they pecked at a green bill. The differences were statistically significant.

We concluded that the red color of the bill of the adult breeding Franklin's Gull is, at least in part, an adaptation to stimulate and direct the initial feeding responses of the downy young.

Department of Biology, Illinois College, Jacksonville, Illinois, July 8, 1956.

NOTES ON THE SONG SPARROWS OF THE MEXICAN PLATEAU

BY ALLAN R. PHILLIPS AND ROBERT W. DICKERMAN

THE historic explorations of México by E. W. Nelson and E. A. Goldman brought to light many new subspecies of birds. Among these were two races of the Song Sparrow (*Melospiza melodia*). A third race had been described previously by Ridgway. It is strange that, in the more than half-century that has elapsed since, a species so justly famed for its plasticity has been so neglected by ornithologists. Since the description of Nelson's races, no critical studies have been made of the Mexican populations.

These populations are effectively isolated from one another by their strict selection of moist, marshy, or stream-side habitats; these are usually separated by arid uplands or mountain barriers. The birds are most frequently encountered in or about cattails, bullrushes, or sedgy meadows. The populations at Yuriria (Guanajuato) and Pátzcuaro (Michoacán) are found at the lake edges where there are abundant growths of cattails and other emergent vegetation. Yet to date no Song Sparrows have been reported from Lake Chapala (Michoacán and Jalisco), with its extensive borders of seemingly suitable habitat, nor from other suitable-looking habitats in Jalisco and Nayarit. At the Criadero de Fauna Cinegetica at San Cayetano, 8 kilometers south-southwest of Villa Victoria (State of México), the birds were found along the grassy borders of a small stream with scattered bushes and a large umbellifer (kindly determined by Prof. Maximino Martinez as *Arracasia atropurpurea*), as well as *Mimulus*, in the open pine forests. At El Río (State of México), they were common along the Lerma River, where it is bordered by marshy meadows. Several at this locality were taken in a farm yard bordered with hedges of large *Agave*, a few hundred yards from the river, where they mingled with the English Sparrows and *Oriturus superciliosus*. Song Sparrows were found in cattails and rushes in drainage ditches bordering pastures and fields of corn and alfalfa near Tenango del Valle in the Lerma Valley (State of México), at Xochimilco (Distrito Federal), and at Tulancingo (Hidalgo). Five miles west of Ciudad Tlaxcala their habitat was similar, where fields were being ditched and drained from the edge of a marsh. Throughout several of the suburbs of Mexico City where the vegetation is essentially riparian, especially in Chapultepec Park, Song Sparrows are abundant. In Durango they occur along streams bordered by willow brush and, in places, by bunch-grasses.

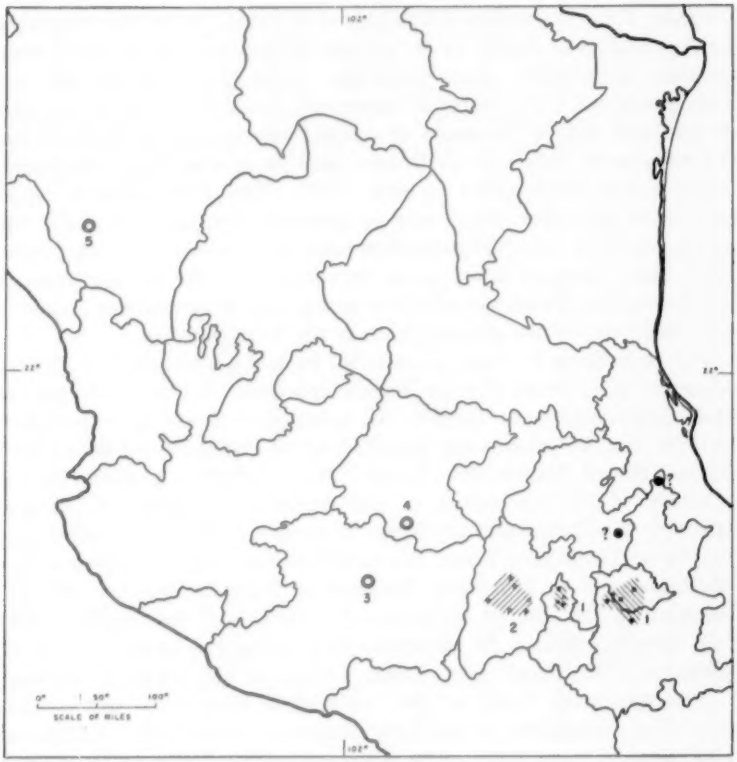


FIGURE 1. Distribution of the Song Sparrows of the Mexican Plateau. 1. *Melospiza melodia mexicana*, 2. *M. m. villai*, 3. *M. m. adusta*, 4. *M. m. yuriria*, and 5. *M. m. goldmani*. Question marks represent populations tentatively to *M. m. mexicana*.

Curiosity regarding the alleged occurrence of *Melospiza melodia merrilli* in Sonora, subsequent field observations, and examination of certain specimens in the collection of the Instituto de Biología, Universidad Nacional Autónoma de México, led Phillips to believe that the plateau populations were in need of revision. Soon afterward, Dickerman, while doing field work for the University of Kansas, was able to collect winter-plumaged series from certain southern parts of the plateau, and J. Dan Webster and Phillips took the first fresh fall-plumaged topotypes of *M. m. goldmani*. Dickerman revisited all populations under consideration in 1956 and collected fall-plumaged specimens of all except *goldmani*. Comparison of

October, 1956, specimens with those of October, 1910 from the same locality indicates foxing to be of such magnitude as to make comparisons with older skins worthless. Seasonal color changes are also prodigious. The rate of foxing in the series available was not determined; but to eliminate all errors, only specimens taken in the fall seasons of 1955 and 1956 were used in making final color comparisons and descriptions in early 1957. The 1956 series are part of a more extensive study now in progress; consequently, only the specimens from the 1956 collections used as types are annotated here. With these recently taken series, in addition to the critical series of specimens from México available to us by loan, we are able to present a brief summary of the plateau races of the Song Sparrow.

For permission to work on material from the University of Kansas Museum of Natural History we are indebted to Drs. E. Raymond Hall and Harrison B. Tordoff; for permission to examine specimens in their care, we express our appreciation to Professors Bernardo Villa R. and Rafael Martín del Campo. We are further grateful for the courtesy of the authorities of the American Museum of Natural History, the California Academy of Sciences, the Agricultural and Mechanical College of Texas, the United States National Museum, and the University of Minnesota Museum of Natural History. We are indebted to Dr. George M. Sutton for the loan of specimens, and to Ing. Cenobio Blanco for assistance in locating the habitat of *M. m. goldmani*. We thank Mrs. Helen Chapman for drawing the map.

The specimens listed in the "specimens examined" sections are only those compared in the later stages of this study. Additional specimens of some races were examined earlier. For measurements see Table I.

At present, we recognize formally five plateau races, as follows:

(1) *Melospiza melodia mexicana* Ridgway.

(?) *Melospiza pectoralis* von Müller, Reisen in den Vereinigten Staaten, Canada, und Mexico, 3: 583, 1865, "Auf dem Hochland von Mexico" (type lost).

Melospiza melodia var. *mexicana* Ridgway, in Baird, Brewer, and Ridgway, History of N. Am. Birds, 2: 18 (footnote), 1874 ("Puebla"; type in U. S. National Museum).

Diagnosis.—Darker than any other previously named Mexican subspecies. Agrees with other races of the southern plateau in broad black streaking above and below (including the upper tail coverts), in dark color of the tibia (deeper than one *M. m. "mailliardi"* at hand, but redder than *morphna*), and in relatively short tail. The only other dark race, the following, is larger and still darker. Less intensely reddish *adusta* and other more western birds in fall.

Distribution.—Valley of México, and Puebla and Tlaxcala in the valleys east of Mts. Popocatépetl and Ixtaccíhuatl; also perhaps Tulancingo, Hidalgo. Reported from Huexotitla, Puebla.

TABLE 1

MEASUREMENTS IN MILLIMETERS OF THE RESIDENT MEXICAN HIGHLAND RACES OF *Melospiza melodia*. AGE CLASSES COMBINED BECAUSE OF LACK OF SUFFICIENT NUMBERS OF FULLY ADULT SPECIMENS FOR SEPARATE TREATMENT. TABLE DOES NOT INCLUDE MEASUREMENTS OF TYPE SPECIMENS, GIVEN SEPARATELY IN TEXT IN SOME CASES

Population	*Number*	*Wing (chord)*	*Tail*	*Tarsus*
mexicana, Tlaxcala				
♂	4	66.5(+?)–69.3 (68.3)	64.3 –66.5 (65.5)	24.4–24.9 (24.6)
♀	4	64.2 –67.2 (65.5)	61.6 –64.6 (63)	22 –24.2 (23)
Valley of México				
♂	9	61.2 –69.7 (66.4)	57.6(+?)–65.5 (61.7)	21.8–24.3 (23.1)
♀	4	61.7 –64.5 (62.6)	58.6 –62.8 (60.3)	21.5–23.2 (22.2)
Tulancingo, Hgo.[1]				
♂	4	66.5 –69 (67.6)	59.5 –65.5 (63.3)	22.2–23.7 (23.1)
♀	1	66.5	63.8	23
villai				
♂	13[2]	68.7(+?)–76 (72.4)	66.5(+) –73.5 (70.2)	24.1–25.6 (24.7)
♀	4	64.5 –70.6 (67.3)	62.5(+?)–65.2 (63.7)	23.9–25 (24.3)
adusta				
♂	8	62.5(+?)–69.6 (66.7)	59 –67.1 (62.5)	22.8–24.5 (23.5)
♀	1	63.8	59±	22.2
yuriria				
♂	3	64.6 –68.3 (66.9)	60.8 –65.3 (63.3)	23 –23.1
♀?	1	65.5	61.1	22.1
goldmani				
♂	5	69.7 –73.6 (71.7)	68.5± –73.3 (72)	
♀	1	67.6	68	

[1] All Tulancingo specimens are badly worn.

[2] One bird meas .ing wing 66.4, tail 65.6 is omitted because of doubt as to its sex; it is marked simply "o".

Specimens examined.—DISTRITO FEDERAL: Xochimilco, 5; Tlálpam, 6; Ixtacalco, 2; also recorded from Ixtapalapa. PUEBLA: Río Otlati (= Otlata), 2 juvs. TLAXCALA: 5 miles west of Cd. Tlaxcala, 6; 8 kilometers southwest of Cd. Tlaxcala, 2; Apixaco, 2. HILDALGO: Tulancingo, 5 ads., 1 juv. (subspecies assumed).

Remarks.—Hellmayr (Field Mus. Nat. Hist., Zool. Series 13, part 11: 608, footnote, 1938) adopted the name *pectoralis*, stating that "Müller's description agrees so minutely with specimens from Puebla that I do not see any reason why his name should not be adopted." To this statement we cannot possibly subscribe. Dr. Frances L. Burnett has kindly furnished us a copy of von Müller's itinerary and his description of "*Melospiza pectoralis*." The outstanding characteristic of all the southern Mexican races is their broad black streaking, yet the word "black" appears only once in von Müller's description; the bill is said to be clear brown, paler below, but all black at the time of pairing! In the series at hand a breeding male (20 June) from Xochimilco had the maxilla black, except along the tomia, but the mandible was grayish and the region about the gonydeal angle, like the bases of the maxillary tomia, pale (rather lavender) drab. This agrees *in part* with von Müller's statement; but a juvenile of the next race (3 July) had the maxilla dark grayish drab, with paler mandible and almost flesh-color gonydeal angle region; it thus seems doubtful that the maxilla would be clear brown in fall. Young *goldmani* taken on 30 September have the maxilla dusky at this writing, four and one-half months later. (These were not described in the field.) Von Müller's specimens were lost in transit, and the description was given from memory. Even assuming that his memory of the plumage was poor, we can hardly reconcile this statement with his itinerary, since he was only in the Puebla and Mexico City areas from mid-September, 1856, to the following January (23, 1857). The measurements given do roughly approximate this species, except for a total length of 125 millimeters; but this is impossibly short for this species, or for any bird whose tail length, like the wing, is given as 70 millimeters. On the whole, the description is too inaccurate to be associated with any particular sparrow; and the locality is given simply as "Auf dem Hochland von Mexico." We cannot but feel that it was an error to change Ridgway's treatment of this dubious name, and that the first name definitely applicable to the Puebla race is *mexicana*.

The population of the Valley of Mexico appears to differ in some ways from that of Puebla and Tlaxcala, but the present material does not allow nomenclatural recognition. No comparisons could be made on the worn birds from Tulancingo.

(2) **Melospiza melodia villai,** subsp. nov.

Type.—University of Minnesota Museum of Natural History, No. 12500, male adult (?); 6 miles north-northeast of Amoloya del Río (= 9 kilometers south-southeast of Lerma), State of México, 24 October, 1956; collected by Robert W. Dickerman, original number 7560. Weight 26.3 gms.; little fat. Skull ossified; testes 1.5 mm. Measurements: total length 173 mm., extent 235, wing 72, tail 69.5, tarsus 24.4.

Diagnosis.—Largest and darkest of the southern races. Anterior upperparts sootier brown and back showing less contrast than in *mexicana*, the light edges of the feathers being deeper, toward olive gray rather than buffy; flanks slightly darker, more tinged with grayish, less buffy. Tarsus more than 23.8 mm., and wing frequently exceeding 70 (♂) or 67 (♀) mm. Tail of male usually longer than 67 mm.

Distribution.—State of México, in the Lerma Valley north at least to Ixtlahuaca, and south at least to Tenango del Valle. Also scattered along open-forested streams west at least to San Cayetano.

Specimens examined.—MEXICO: Ixtlahuaca, 1; El Río (14 miles northwest of Toluca), 5; Lerma, 3; 6 miles north-northeast of Amoloya del Río, 1; San Cayetano, 8; north slope of Volcán de Toluca, 1. Also recorded: Tenango del Valle.

Remarks.—Despite its central position geographically, *villai* is one of the most strongly characterized of the Mexican races.

It is particularly appropriate that the contributions of Prof. Bernardo Villa R. to the advancement of zoology in México be commemorated in the name of this race. It was the sooty appearance of three specimens that he had collected at San Cayetano that gave rise, in part, to our study.

(3) *Melospiza melodia adusta* Nelson.

Melospiza adusta Nelson, Auk, 16: 28, 1899 (Pátzcuaro, Michoacán; type in United States National Museum).

Diagnosis.—The reddest on the upperparts and wing-coverts of all the black-streaked Mexican races. Ground color of flanks and crissum richer, more ochraceous buff than in *villai* or *mexicana*. Also it has more reddish brown on the stripes and sides of the head and in the auricular region. Breast streaks tend to have more reddish edgings.

Distribution.—Known only from Lake Pátzcuaro, Michoacán.

Specimens examined.—MICHOACÁN: Pátzcuaro, 1; Erongarícuaro, 1; southeast arm of Lake Pátzcuaro, 7.

Remarks.—The specimens originally examined by us have unusually pale mandibles; but these may have faded, since the specimens were taken in 1947–1949. Specimens taken in the fall of 1956 do not differ in bill color from other populations. There is apparently no size difference between *adusta* and *mexicana;* Nelson in his original description may have compared *adusta* with some specimens of *villai*.

(4) **Melospiza melodia yuriria,** subsp. nov.

Type.—University of Minnesota Museum of Natural History, No. 12490, male adult (?); Yuriria, Guanajuato, 21 November, 1956, collected by Robert W. Dickerman, original number 7723. Weight 18.4 gms.; little fat. Skull ossified; testes 1.5 mm. Measurements: length 166 mm., extent 223, wing 69, tail 66.6, tarsus 23.2.

Diagnosis.—Most similar to *adusta*, but browner. Wing coverts and tail coverts less deeply reddish, thus intermediate toward *mexicana*. Back showing greater contrast, the edges of the feathers distinctly more grayish, rather than buffy as in *adusta*. Smaller and distinctly lighter and redder than *villai*. Redder throughout than *mexicana*, in fresh plumage, with richer (more ochraceous) flanks.

Distribution.—Known only from Lago de Yuriria, Guanajuato.

Specimens examined.—GUANAJUATO: Yuriria to 1 mile east, 5.

(5) *Melospiza melodia goldmani* Nelson

(?) *Melospiza fasciata mexicana* (not *Melospiza melodia* var. *mexicana* Ridgway) Allen, Bull. Am. Mus. Nat. Hist., 5: 39, 1893, "Bavispee River," *i. e.* (cf. p. 31) probably "Camp 21 on the Bavispee River, 15 miles from Chuchuichupa" (= Chuhuichupa, Chihuahua).

Melospiza goldmani Nelson, Auk, 16: 29, 1899 (El Salto, Durango; type in United States National Museum).

(?) *Melospiza cinerea merrilli* (not *Melospiza fasciata merrilli* Brewster) Ridgway, U. S. Nat. Mus. Bull. 50, part 1: 361–362, 1901, "Bavispe River, N. E. Sonora."

(?) *Melospiza melodia merrilli* van Rossem, Occas. Papers La. State Univ. Mus. Zool., 21: 288, 1945, " 'Camp 40' on the upper Bavispe River."

Diagnosis.—Differing strikingly from any of the preceding races, the black stripes reduced everywhere to fine lines, and the black of the flanks and crissum replaced by chocolate brown. Thighs also chocolate. Larger than any southern race except *villai*, and with relatively longer tail. Much like *caurina* dorsally, but ventral streaking much less extensive. Less richly colored than *morphna:* sootier above, and the ground color of flanks grayer, less buffy. (So much darker above than the next races to the north, *fallax* and *montana*, as to need no close comparison.) It is also very similar dorsally (not ventrally) to *insignis* taken 35 years earlier (*fide* J. Dan Webster, *in litt.*).

Distribution.—Sierra Madre Occidental, very locally; the only presently known localities are El Salto, Durango, and central-western Chihuahua (or perhaps central-eastern Sonora).

Specimens examined.—DURANGO: El Salto to 5 miles west, 6.

Remarks.—A little-known race, apparently represented, up to 30 September, 1955, by only the type series of 2 worn males and a juvenile.

The Lumholtz Expedition to Sonora and Chihuahua was a model of confusion, remarkable not only for the paucity and poor quality of the zoological material collected over a period of two years and the abundant inaccuracies in the report thereon, but also for the vagueness of some of the localities visited. Certainly the names given to the rivers are incorrect. Personal field work by Phillips and Dr. Joe T. Marshall, Jr., has indicated the probability that the Lumholtz camp on the "headwaters of the Bavispe River" was not in Sonora at all! If so, certain other records will, of course, have to be deleted from the Sonora state list, as now understood, such as *Sphyrapicus thyroideus* and *Oriturus superciliosus*. The darker Song Sparrows from that camp do indeed, as Ridgway pointed out, closely resemble *merrilli* in color; their dimensions, however, agree rather with the more southern races. Pending the taking of better material, accurately labeled, we should consider their description as a distinct race unwarranted—though admittedly a good many races of birds have been named from Mexico in recent years on still flimsier evidence. The point we wish to stress is that *merrilli* proper does *not* migrate to the Sierra Madre Occidental, and that the fundamental relationship of the darker specimens taken by Robinette on the Lumholtz Expedition is with *goldmani*. Parenthetically, we know of no valid record of *merrilli* in eastern or central Arizona, nor in southern or central New Mexico, so the taking of two *merrilli* by chance in Chihuahua would be most unlikely. Furthermore, the Chihuahua birds are too large for *merrilli* of eastern Washington, which measures (8 males): wing 64.1 to 69.5 and 71 (av. 66.8); tail 63.8 to 71.9 and 75 (67.8); culmen from base 12.6 to 14 (13.4); and bill from nostril 8.1 to 8.9 and 9.5 (8.6) mm. Corresponding measurements of Chihuahua birds are: male, 72.9, 75.5, 14.5, 9; female, 67.1, 65.5, 15, 9.7 mm.

Museum of Northern Arizona, Flagstaff, Arizona; and University of Minnesota Museum of Natural History, Minneapolis, Minnesota (formerly of University of Kansas Museum of Natural History, Lawrence, Kansas), May 3, 1956.

GENERAL NOTES

Species Limitation in Certain Groups of the Swift Genus *Chaetura*.—Dr. David Lack in a recent resumé of the nesting habits of swifts (Auk, 73: 11–12, 26, 1956) has made the tentative suggestion that the Chimney Swift (*Chaetura pelagica*), Chapman's Swift (*C. chapmani*), and Vaux's Swift (*C. vauxi*) might be grouped conveniently as a single species since the first and last, at least, have similar nesting habits, while all three present a color pattern of general similarity. The nesting of the little-known Chapman's Swift does not appear to have been discovered, but that of the Chimney Swift and of the typical race of Vaux's Swift (*Chaetura vauxi vauxi*) are well known, and there is one record for the subspecies *Chaetura vauxi richmondi*. These are similar as to form of nest and location, as Dr. Lack has said. The general agreement in color that he points out also is clearly evident in museum skins and might in fact be extended to include all the American species of *Chaetura*, since all have such close resemblance that care and experience are necessary to distinguish them. The species vary in general body color from plain grayish brown to a black that sometimes has a slight greenish iridescence; while the rump and upper tail coverts—including in some cases, the rectrices also—range from a pale brownish gray to a duller shade that is almost like that of the back. It is obvious that the genus is one in which close superficial similarities are the rule, so that to separate the species it is necessary to scan closely for details that would be disregarded in a group of greater diversity. The Chimney Swift probably is the most abundant, as it is common through a breeding range extending from southeastern Saskatchewan and southern Quebec south through the eastern half of the United States to southeastern Texas and central Florida. In this great area it remains stable in color and size. Vaux's Swift as a species occupies a considerable area also (but with remarkably discontinuous range), from southeastern Alaska and northern British Columbia south through México and Central America to Panamá, with an isolated group in northern Venezuela. Six geographic races, in which the northern and southern groups differ considerably, are recognized. They may be common locally, but are absent in considerable areas of the indicated range. Chapman's Swift, the least known of the three, is recorded from central Panamá (Gatún), northwestern Colombia (Antioquía), Trinidad, north central Brazil (Mato Grosso) and Cayenne. Two geographic races have been proposed. It is possible that its breeding range overlaps that of one or more of the races of *vauxi*, in Panamá and northern Venezuela. With this background of general information the three species may be considered now in detail.

In bulk Chapman's Swift is not unlike the Chimney Swift, but differs in having a wider wing, the inner secondaries being not only longer but also relatively broader, while the primaries are definitely broader. The alula is longer. However, total wing length in the two species is about the same. The under tail coverts in *chapmani* are slightly shorter in relation to the rectrices (a characteristic that needs to be checked with care, since in many museum specimens of *pelagica* the longer under tail coverts have been lost in skinning). Add to these differences the larger feet of Chapman's Swift and its contrasted pattern on the dorsal surface, in which the head, back, and wings are black, or black with a slight greenish sheen, and the rump, upper tail coverts, and tail are grayish brown, compared to the smaller feet and the more uniform pattern of the Chimney Swift, with only the wings black and the rest of the dorsal surface dull brown, becoming only slightly paler toward the tail, and it will be seen that while superficially similar, in detail the two are different.

To pass to the next species, it may be remarked at once that the Chimney Swift,

in addition to its definitely greater bulk (and its impressive migration) differs from the Vaux's Swift group in voice. The note of *C. pelagica* is a clear, sharply enunciated chipper, sometimes uttered at brief intervals, but frequently repeated rapidly so as to form a rattling chatter. The calls of Vaux's Swifts are much weaker, with little carrying power, and are given in a wheezing, high-pitched tone so that even when repeated rapidly they do not approach the notes of the larger species. One is conscious of the presence of Chimney Swifts when they are active because of their notes, but seldom is attention attracted by the calls of the tropical forms of Vaux's Swift, and then only when they are very near at hand.

As to structure Vaux's Swift differs definitely from both *pelagica* and *chapmani* in having much less bulk of body, a fact easily appreciable when museum skins of equivalent style in preparation are laid side by side. The total wing length also is less, and the carpal or "hand" portion that supports the primaries is smaller and shorter. Thus the proportions of the parts of the wing are different. *C. vauxi* agrees with *chapmani* and differs from *pelagica* in having shorter under tail coverts, and differs from both in having shorter upper tail coverts.

Hence it appears to me now, as it has before in going over these matters, that *Chaetura pelagica*, *C. chapmani*, and *C. vauxi* are to be regarded as distinct species, and that to combine them into one would be misleading and confusing. In the purely theoretical field the Chimney Swift possibly may be older in evolution than the other two, since it would appear probable that it became established in eastern North America during the latter part of the Tertiary; its present migratory habit was then developed through the Pleistocene. Whatever tendencies it has had toward variation have become stabilized, so that its population is quite uniform through an extensive range. Vaux's Swift, on the other hand, exhibits definite variability and may be a younger stock that has extended its range more recently. The little that is known of Chapman's Swift leaves it in an indefinite status, though from its rarity through the extended area in which it has been found it would appear less successful than the other two. Possibly it is an older type that is in the process of disappearance.

As a further suggestion, the pale northern race of Vaux's Swift (*C. v. vauxi*) in comparison with the larger *C. pelagica*—and the darker, more southern *C. v. ochropygia* and *C. v. aphanes* in comparison with the larger *C. chapmani*—seem to offer an analogy of similarity in color pattern but difference in size like that found in the swift genus *Panyptila* with its two beautifully marked species, the large *P. sanctihieronymi* and the small *P. cayennensis*.

As a final word, after many years during which I have observed and at times have collected (or have attempted to collect!) swifts of various kinds, I am reluctant to agree with Dr. Lack that in their feeding they may not emulate or exceed the erratic dodging through which the somewhat similarly formed swallows secure their aerial insect prey. The only obvious difference in the feeding of the two is that swifts fly regularly at higher elevations above the ground than swallows, and thus in the tropics range across extensive areas of high forests. Swallows, however, may join them when high-flying food is abundant, and swifts, conversely, may course low over grassland, so that the distinction is not clear-cut. It would appear that both families of birds have like habits of gathering food, except that in the swifts they are geared to a racing speed where the wing may be quicker than the eye, while in the swallows there is more leisurely movement. Swifts undoubtedly travel farther per unit of food obtained than do swallows, though why this should be necessary appears difficult to understand. Greater restriction in suitable nesting and roosting places for swifts might be advanced as a reason; if this is really a control,

there should be some other adaptation to compensate. Perhaps speed is that compensation. But on the other hand, to resort to an anthropomorphism, may not some birds, like some men, enjoy racing while others are content with a slower pace? It is only necessary to watch a flock of swifts, particularly the larger species, coursing in the wind to realize that there is no evident reason other than enjoyment for the tremendous rapidity with which they often travel.—ALEXANDER WETMORE, *Smithsonian Institution, Washington 25, D. C.*

The First Primary in Swifts.—The object of this note is to follow up in other swifts a point that I reviewed earlier in the species of *Apus* (Ibis, 98: 34–62, 1955). The first primary is about 5 mm. shorter than the second in *A. apus, A. caffer, A. horus, A. pacificus* (except one race), and *A. myoptilus* (5 further specimens seen); but the two feathers are about equal in length, giving a more rounded wing-tip, in *A. barbatus, A. pallidus, A. melba, A. aequatorialis, A. affinis,* and *A. pacificus cooki.* The forms of *Apus* with more pointed wings also have more forked tails, and in *A. caffer* and *A. myoptilus* the outermost rectrix is not only much longer than the next but is much emarginated on its inner web. In what follows, I have used my revised classification of the Apodiforms (Auk, 73: 1–32, 1956), but accepting the corrections by Bond (Check-list of Birds of the West Indies, 4th ed., 1956: 88–90) and Wetmore (Auk, 74: 383–385, 1957) to the effect that *Chaetura martinica, C. vauxi* and *C. chapmani* are distinct species.

Other Apodinae.—The first primary is about 5 mm. shorter than the second in *Cypsiurus, Aëronautes, Tachornis squamata,* and *T. phoenicobia,* and some 2 to 3 mm. shorter in *Panyptila cayennensis.* The difference is relatively greatest in the smallest species (*Cypsiurus* and *Tachornis*), perhaps for aerodynamic reasons. The tail is deeply forked, with a much emarginated outermost rectrix, in *Cypsiurus* and *Panyptila,* well forked in *T. squamata,* less so in *T. phoenicobia,* and but slightly forked in *Aëronautes* (to an extent which, in *Apus,* would be associated with first and second primaries of equal length).

Chaeturinae.—In *Collocalia,* the first primary is about 5 mm. shorter than the second in all 8 species that I examined (the average differing somewhat with the species); the tail is not, or barely, forked. In *Cypseloides* (*sens. lat.*), the first primary is shorter than the second (by about 4 mm.) in only one species that I saw, namely, *C. rutilus.* It is about 1 mm. longer than the second in *C. niger* and *C. fumigatus,* and 3 to 5 mm. longer in the large *C. zonaris, C. biscutatus, C. semicollaris,* and *C. senex.* I did not see the other species. The tail is not forked in most species, slightly forked in *C. rutilus, C. niger,* and *C. biscutatus,* and more so in *C. zonaris.*

In *Chaetura,* as in *Cypseloides,* the first primary tends to be longer, not shorter, than the second: nearly 5 mm. longer in *C. cassini,* about 2 mm. longer in *C. sabini* and *C. leucopygia,* and slightly longer in 9 or 10 other species, *C. ussheri, C. sylvatica, C. melanopygia, C. caudacuta, C.* (*s.*) *cochinchinensis, C. gigantea, C. pelagica, C. vauxi, C. spinicauda,* and *C. cinereiventris.* On the other hand, it is slightly shorter than the second in *C. boehmi* and *C. grandidieri,* some 2 to 3 mm. shorter in *C. novaeguineae* and perhaps *C. andrei* (only one specimen seen), and 5 mm. shorter in *C. brachyura.* These differences run counter to the natural subdivisions of the genus, in which, for instance, all the American forms come close together. The tail is not forked in *Chaetura,* and in five species it is extremely short. Three of these short-tailed species, *C. brachyura, C. novaeguineae* and *C. boehmi,* also differ from most other species in having the first primary shorter than the second; but in the fourth species, *C. cassini,* the first primary is markedly longer than the second. (The fifth species, *C. picina,* was not examined.)

Hemiprocnidae.—The first primary is some 3 mm. longer than the second in *H. mystacea* and slightly longer in *H. comata*, but in *H. longipennis* it appears to be slightly shorter than the second primary in most forms, and in *H. l. coronata* it is about equal. In all three species the tail is deeply forked, with the outermost rectrix strongly emarginated. These birds, unlike other Apodi, settle freely on trees and have much less modified wings.

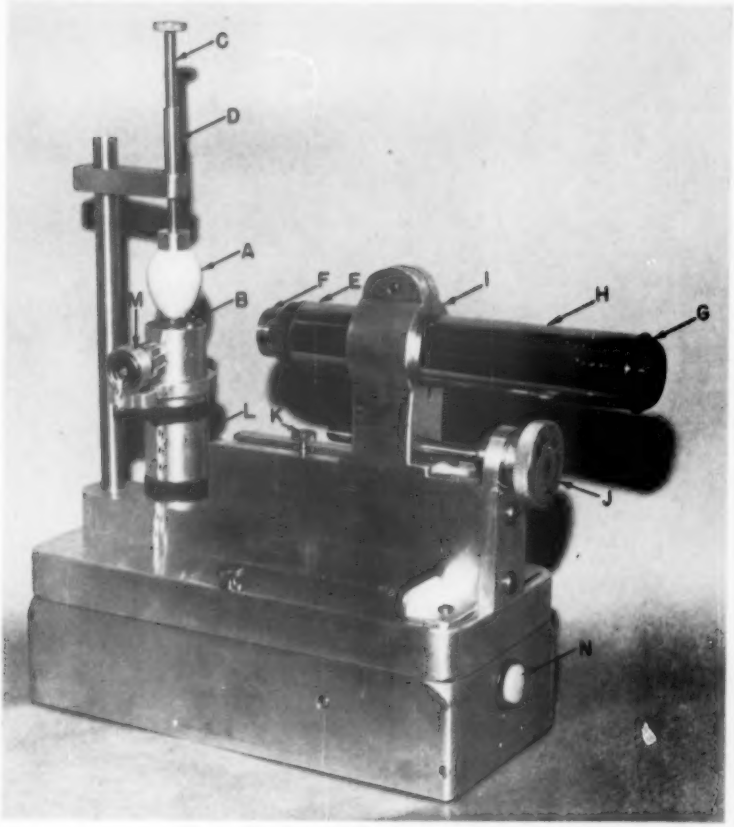
Conclusion.—In all swifts, the first primary differs from the rest in having a pointed, not rounded, tip, due to some emargination of the inner web. Hence by fully spreading the wing, a small gap can be made between the first and second primaries, and I have just been able to see such an apparent gap in a Common Swift (*Apus apus*) in slow flight near me. Presumably this gap functions as a wing-slot, and the difference in length between the first and second primaries, reviewed in this note, is doubtless associated with it in some way. The emargination of the outermost rectrix, where present, may also help in giving greater control in slow flight. Presumably, the difference in length between the first and second primaries is an aerodynamic adaptation, and I had expected that its apparent correlation with the extent of the tail-fork in the species of *Apus* might be repeated in the other genera of swifts. The present survey shows, instead, that the condition is complex. A detailed study of the flight actions of different types of swift will probably be needed before the differences described in this note can be satisfactorily interpreted.—DAVID LACK, *Edward Grey Institute of Field Ornithology, Oxford University, Oxford, England.*

Two New Devices for Measuring the Shapes of Birds' Eggs.—I have described previously (Auk, 70: 160–182, 1953) a device for copying the profile of an egg and so obtaining a complete description of its size and shape. This apparatus yields information of great accuracy, but in too complicated a form to be useful in routine work. M. E. Gemperle and I have also described (Auk, 72: 184–198, 1955) an apparatus for measuring the length, maximum breadth, and curvature of the two ends. In the last application this is a special form of spherometer. The apparatus works well for fairly large and robust eggs, but the pressure exerted by the plunger of the dial gage is too severe for small eggs, which are distorted or even crushed by it. This happens even with the finest jewel-bearing dial gages. It is, however, in regular use at Carnegie Museum for measuring the eggs of the larger species.

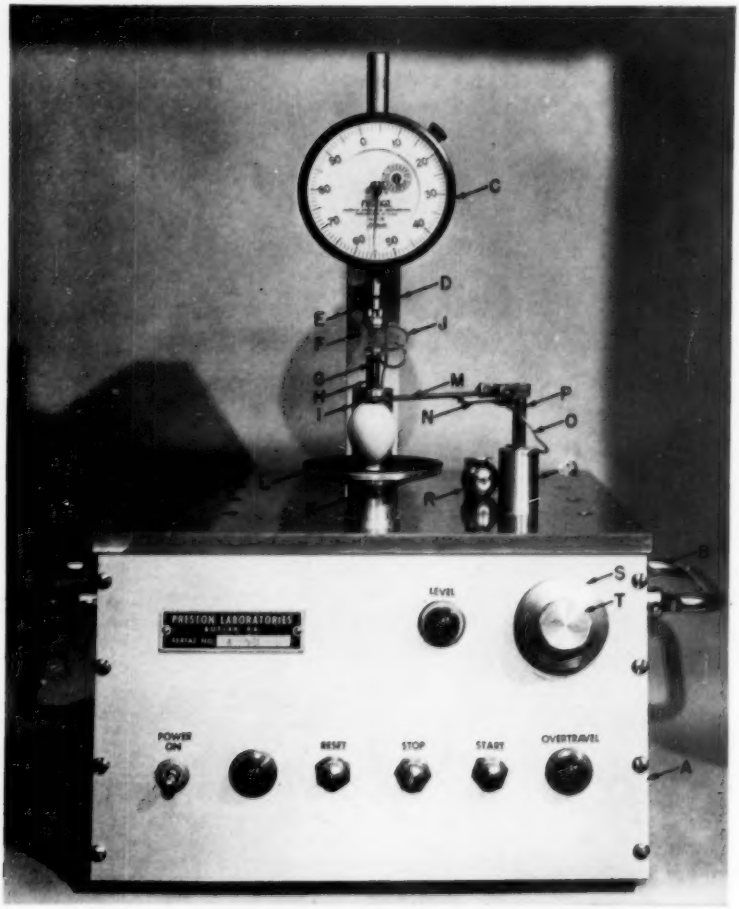
To deal with the eggs of the majority of the passerines and other small species, two new devices were added to the battery of instruments. One of these is an optical spherometer for measuring the curvature of the ends of eggs; the other is an automatic electrically operated machine for measuring length and breadth. A brief description of each follows.

Optical spherometer.—The "key move" in any spherometer for measuring birds' eggs is to set the egg upon three hard steel ball bearings arranged in an equilateral triangle. Upon these very smooth, highly-polished surfaces the egg will seat itself correctly; it will not seat itself properly on an ordinary "ring" or "tripod" type of spherometer. The steel-ball seat was used in the instrument previously described and also in the present instrument. Plate 16 shows an egg (A) of the European Starling (*Sturnus vulgaris*) seated, pointed end down, on the three steel balls (B) and held in place by the weight of a light aluminum shaft (C) sliding freely in a fixed sleeve (D).

The gap between two of the three steel balls faces the microscope (E), which has a long "working distance," i.e. a long distance between the object glass (F) and the object under scrutiny, in this case the end of the egg. It has also a fairly long "eye-



OPTICAL SPHEROMETER FOR MEASURING CURVATURES OF THE ENDS OF RELATIVELY SMALL OR FRAIL BIRDS' EGGS.



AUTOMATIC MACHINE FOR MEASURING THE LENGTH AND BREADTH OF RELATIVELY SMALL OR FRAIL BIRDS' EGGS.

point," i.e. the distance between the human eye and the eye-piece (G) of the microscope.

Inside the microscope tube at a point represented approximately by the arrow (H), at the common focus of object glass and eyepiece, is a reticule which reads vertical distances to 0.001 inches. The zero point of this scale is adjusted to correspond with the center of the horizontal triangle represented by the highest points of the three balls, the "reference plane." An infinitely large egg, if it can be imagined, would therefore read zero. The adjustment is made by passing a needle point up between the three balls until it touches an optical flat resting on the three balls; the flat is then removed, the needle remaining in place. The carriage (I) which holds the microscope is then traversed by the screw (J) until the needle is in sharp focus, and then locked permanently in position by the lock screw (K). The height of the pedestal (L) that carries the three balls is now adjusted until the top of the needle reads zero on the scale. The calibration is checked by setting steel balls of known diameter on the other three and observing that the image of the lowest part of these balls comes to the calculated place on the reticule.

A small electric lamp (M) throws a beam of light horizontally through a small hole in the pedestal below the level of the steel balls, and a stainless steel mirror set at 45° to the vertical axis reflects this light vertically upwards so that it strikes the apex of the egg. This causes the image of the egg to appear white against a dark background. The boundary between light and dark is conspicuous and easily read in the microscope, which has a magnification of 40 diameters. The light is off except when the button (N) is pressed, connecting flashlight batteries, in the base of the instrument, to the bulb.

The instrument is "direct reading," the zero being permanently in place, and only one reading is necessary to determine the "sagitta" or "sink," from which the curvature can be obtained directly as explained in a previous article (Auk, 72: 184–198, 1955).

The steel balls are 10 mm. in diameter. The instrument scale reads in thousandths of an *inch*, but the curvature can be looked up in a table and read directly in millimeters.

The microscope is a standard instrument made by Bausch and Lomb; the mechanical parts of the instrument were made by Mr. George Wiest of the Preston Laboratories.

Automatic Measuring Machine for Birds' Eggs.—This machine, as mentioned above, is intended to measure the length and breadth of eggs that are too small and frail to stand the pressure of the dial gage plunger. It is suitable for eggs up to an inch (25 mm.) in length or a little more, but could readily be adapted to larger eggs. However, eggs larger than this are usually robust enough to be measured with the direct piston pressure on the instrument described earlier. Plate 17 is a front view of the instrument, with an egg of the Starling (*Sturnus vulgaris*) in place.

The plunger travels somewhat more than 25 millimeters, but the first digit (the number of centimeters, 0, 1, or 2) is not read from the dial, which reads in millimeters (up to ten) and hundredths of millimeters. There is no difficulty in estimating the number of centimeters and inserting it in the result.

The base of the instrument is a massive aluminum box, filled with heavy machinery, the details of which do not concern us here. It is supported on four legs or pads and is lifted by the handles (B). It operates on a 110-volt, 60-cycle circuit, like that of the ordinary domestic power lines.

The dial gage (C) is supported rigidly from a massive pedestal (D) at the back. The spring pressure of the piston (E) is taken up on a yoke (immediately below the

arrow, E) attached to another piston (H), passing vertically through the pedestal (I), and this piston (H) is moved up and down by an electric motor in the base.

Below the piston is connected a hollow, cylindrical, plastic cage (F), through the bottom of which there passes a thin platinum needle or feeler (G). This floats in the cage and is connected by a very fine spiral wire, inside the cage, to the piston above.

The egg to be measured is placed on the top of a pedestal (K), around whose top is a sort of saucer (L) lined with velvet, to catch the egg if it should slip off the pedestal.

There is still another pedestal (Q) through which passes a manually operated piston (P), to whose top there is pivoted a horizontal arm (M) whose weight is just sufficient to keep the largest eggs we intend to measure from slipping out of position. When the weight of this arm is not being carried by the egg it is carried by the electric contact (N), which is connected by the wire (O) with the works in the base.

R is a 20-millimeter steel ball, used to check the calibration. With the ball substituted for the egg, the dial is required to read zero when it stops automatically.

S is a coarse manual adjustment for raising or lowering piston (P), and T is a fine adjustment. In practice T is used virtually all the time and S very little.

The method of operation is as follows. From a plug at the rear the instrument is connected to the electric mains and the "power on" switch is turned on. This lights the little glow lamp to the right of the switch. Push the "reset" button: the piston of the dial gage travels to the top of its stroke and cuts off its own activating power. Turn knob (T) to rack plunger (P) high enough to place the egg under arm (M); then lower arm, by means of knob (T), until it touches the egg. The light marked "level" will be on until we lower the piston (P) to a point where the pressure is taken off N and transferred to the egg. When this happens, arm (M) is level and the light goes out. The moment it goes out it is time to cease turning knob (T).

Assuming that the egg has been correctly positioned (vertical in the case shown), we are now ready to measure its length. Press the "start" button. The dial gage piston (E), cage (F), and platinum feeler (G) descend, very rapidly at first, the needle of the dial gage spinning around too rapidly to be seen. But as the feeler nears the arm (M), a differential gear is thrown into the system and the speed drops to one fifth. The instant the feeler touches a thin platinum disc soldered to the top face of arm (M), an electric circuit is completed and the motion stops dead. The dial gage now gives directly the length of the egg.

We may repeat the measurement by first pushing the "reset" button to raise the piston, and then the "start" button to lower it. The instrument will repeat to about 0.001 mm., which is 1/25,000 of an inch or two wave lengths of yellow light. There is, however, no point in recording to more than the second decimal place (0.01 mm. or 1/2,500").

The platinum feeler, being of negligible weight and floating freely in the plastic cage, exerts no significant pressure on the egg, and the arm (M) is also very light—just heavy enough to support an empty egg-shell. It will, of course, not support an unblown egg.

The instrument is probably delicate enough to measure the thermal expansion of egg shells, their variation with humidity, and any change arising with the passage of time, such as might occur from the drying of the protein or the recrystallizing of the inorganic fraction. On some of these matters we may report later. It will be used at first for the simple purpose of measuring egg sizes in a routine manner. —F. W. PRESTON, *Preston Laboratories, Box 149, Butler, Pennsylvania.*

Incubation and Nestling Periods of the Olive-sided Flycatcher.—In 1955 Walkinshaw found a nest of the Olive-sided Flycatcher (*Nuttallornis borealis*) in a sparsely wooded bog in Schoolcraft County (T47N, R13W, Section 5), Michigan. The undergrowth was predominantly sphagnum moss with protruding individuals or groups of black spruce (*Picea mariana*) and tamarack (*Larix laricina*) and a ground cover of cranberry (*Vaccinium*), leatherleaf (*Chamaedaphne calyculata*), swamp laurel (*Kalmia polifolia*), Labrador tea (*Ledum groenlandicum*), and bog-rosemary (*Andromeda glaucophylla*). The nest was 14 feet up on a horizontal black spruce branch, about 18 inches from the trunk and well hidden among the spruce needles. It contained three eggs on June 25 and two young on July 2.

On June 19, 1956, W. Powell Cottrille and Walkinshaw found another nest less than 50 feet from the 1955 nest. The female was carrying nesting material as they watched her. She gave a continuous "position call" of "*Whup-whup-whup.*" This nest was 15 feet above the bog and one foot from the trunk in almost the same relative position as the 1955 nest in another black spruce. On June 22 there were no eggs in the nest, but on June 25 in the late evening the female was sitting on the nest; we examined it June 26 at 6 A.M., finding three eggs. When Walkinshaw and William Dyer left the area on July 6, the female was still incubating three eggs. C. J. Henry and Robert Sundell watched it periodically thereafter. On July 10 at 4 P.M., there were three eggs; on July 11 at 4 P.M., one egg and two young; and on July 12 at 4 P.M., three young, giving an incubation period for the last-laid egg of 16 or possibly 17 days. The young remained in this nest until July 27, at which time they all "erupted" when the branch was bumped with the pole mirror used to examine it. This was 16 days after the first two and 15 days after the last one hatched. Possibly they might have remained in the nest another day or two. One of the young was taken and deposited in the University of Michigan Museum of Zoology.

Betty Cottrille found a nest in the same area about one-fourth mile away, and again in the same relative position, about 15 feet up on a horizontal black spruce branch. Ed DeRosia and Walkinshaw nailed slats on another spruce three feet from the nest tree and made periodic trips to the spot. After July 6 they were joined by DeRosia, Henry, and Sundell. This nest was found June 22, 1956 as the female was building. On June 25 in the early morning it contained one egg, and on June 27 at 6 A.M., three eggs. On July 12 there were still three eggs, but on July 13 at 6 A.M. there were two young and one egg. On July 14 at 6 A.M. there were still only the two young and the egg was gone. Incubation again required either 16 or 17 days. The young remained until July 30, when they left as DeRosia climbed the tree nearby, 17 days after they had hatched. They, too, might have remained a day or two longer if left undisturbed.

This nest was collected. The exterior was made of twigs of black spruce lined with *Usnea*. On the interior, it measured 62 mm. from front to back, 76 mm. in width, and 20.8 mm. in depth. On the outside it measured 150 mm. in width and 45 mm. in depth.

The one young taken by Henry, July 27, 1956, when it was either 15 or 16 days old, somewhat resembled an Eastern Kingbird on the back; its breast was similar to that of the adult, with a slight yellowish tinge. The lower mandible was yellowish; the upper, dark gray. The wing measured 59 mm.; the tarsus, 15.7 mm.; and the exposed culmen, 12 mm.

A Sharp-shinned Hawk nest with four young, found July 3, 1956 by William Dyer and Powell Cottrille, was almost directly between these two nests, but out

of the six eggs the flycatchers fledged five young.—LAWRENCE H. WALKINSHAW, *1703 Wolverine-Federal Tower, Battle Creek, Michigan, and* C. J. HENRY, *Seney National Wildlife Refuge, Seney, Michigan.*

Display of the Least Grebe.—On April 30, 1956, Marian Zimmerman and I watched two Least Grebes (*Podiceps dominicus*) indulge in what appeared to be courtship behavior on a small forest pond 55 miles southeast of Escárcega, Campeche, México. The pond occupied less than half an acre and I doubt if any other grebes were present. I believe the two birds were male and female, though I cannot be certain of this. One was slightly larger than the other.

When first seen the grebes were swimming and feeding within a few feet of each other in open, sun lit water not far from the deeply shaded edge of the pond. As we watched from a distance of 20 or 25 feet, the birds approached to within six or eight inches of one another until they were side by side and headed in the same direction. Suddenly both simultaneously rose so that their bodies were about half out of the water, and their necks extended forward and upward, their bills pointing at approximately "10 o'clock" (see Figure 1). Their head plumage, especially

FIGURE 1. Mutual display of the Least Grebe.

that of the throat, was somewhat fluffed out. In this position they rapidly glided forward for three or four feet and quickly lowered their breasts into the water, stopping suddenly. Both birds preened, dabbed about in the water with their bills as if feeding, then without obvious preliminaries again rose and glided three or four feet. This process was repeated five times in five minutes. Each glide was terminated by a few seconds of preening and bill-dabbing. Throughout the performance *one* bird uttered a high-pitched, nasal *nyĕ-nyĕ-nyĕ-nyĕ* much of the time. Their black throat-patches and golden-yellow eyes were conspicuous.

The appearance of another person may have prematurely terminated the display. At any rate, they swam off through the vegetation and were lost from view. Meager though these notes are, they seem to represent the only recorded observations on the displays of this common bird.—DALE A. ZIMMERMAN, *Imlay City, Michigan.*

Flight Behavior of a Flock of Slate-colored Juncos in the Late Afternoon.—In observations on a flock of Oregon Juncos (*Junco oreganus*) at a feeding station in Deep Springs, Inyo County, California, it was noted that flight behavior at the end of the afternoon was sometimes markedly different from that observed at other times of the day. A group of late-feeding birds tended to leave together and to fly in a direction that was always the same when this behavior was observed.

Between January 3 and March 9, 1954, a flock of nine color-marked Slate-colored Juncos (*J. hyemalis*) was watched for fifty-two days at a feeding station in Ithaca, New York, to see whether similar behavior could be detected. On 28 days the flock made no late visit to the station. On six days there were visits which might have been late enough to be the last feeding period of the day, but no distinctive behavior occurred. On 18 days the flock's final flight behavior was distinctly different from that displayed in its normal daytime visits. (1) Each bird, when it finished feeding, perched for a short time, perhaps a half minute to a minute, at the station. (2) The birds gradually assembled in a dense clump of arbor vitae about forty feet from the station. After they were all collected there was a pause of from three to five minutes during which they made small movements in the bush. (3) The whole flock then left the arbor vitae together, closely following one another. (4) The flock then flew as a group into some adjacent tree, climbed high in it, took off from its highest branches to the highest branches of a neighboring tree, and so moved along a ridge toward the northeast. This was not a swift, directed flight but was sometimes interrupted by short periods of perching. The same trees were not always used, though certain trees were favorites. The direction of flight, however, was invariable. Since the branches of the deciduous trees were clearly outlined against the sky, the flock's progress could be observed with no difficulty.

This behavior was highly distinctive of the late afternoon flight, and different from the birds' usual daytime behavior in several respects. The whole flock moved together; it flew higher than was usual; the flocking was close; and the direction was the same on each of the eighteen occasions when this behavior was observed. It seems a reasonable conjecture that the flock had a common goal, and this in turn suggests the hypothesis that a common roost may be a feature of the integration of junco flocks.—WINIFRED S. SABINE, *Ithaca, New York.*

Redheads Killed by a Downdraft.—At about 3:00 P.M. on March 4, 1956, on the east side of Horsetooth Reservoir, Larimer County, Colorado, I observed a flock of approximately 40 Redhead Ducks (*Aythya americana*) flying northward, with the wind, about 25 yards above the ice. The ice was just starting to break up. Strong, gusty winds had been blowing all day. At this time I heard the telephone wires whistle above me and immediately felt a strong downdraft. The ducks were caught in the downdraft and driven down toward the ice. Seven were killed or so disabled that they could not take flight again. Four were killed outright. They struck so hard that discolored skid marks from six to ten feet long were clearly visible behind them. One was injured so that it could neither walk nor fly, and remained sitting upright on the ice. The other two evidently suffered broken wings, but were able to walk to fissures in the ice and swim away.

The weather was perfectly clear and the ducks had been flying swiftly with the wind, indicating that they had not mistaken the ice for open water with the intention of landing. Moreover, the ice was breaking up and roughened on the surface, so that it contrasted distinctly with the open water in the coves.—HENRY RATE, *School of Forestry, Colorado A. & M. College, Fort Collins, Colorado.*

Observations on the Diving of the Surf Scoter (*Melanitta perspicillata*).—On November 4, 1953, near Lopez Island, San Juan County, Washington, I watched a male Surf Scoter diving. This bird, one of a flock of five, was feeding in salt water (depth probably two or three fathoms) 50 yards or so from the rocky shore of Lopez Island, near the ferry slip. The bird submerged with an initial movement of half-spread wings. On one occasion, when the bird was facing me, I could see that it began its dive by lunging forward and slightly upward so that the breast and belly cleared the water. At the same time the wings, strongly flexed at the wrists, were extended. The bird did not begin its dive by beating the water with the leading edges of its wings; instead, it began in a forward lunge propelled by the feet.

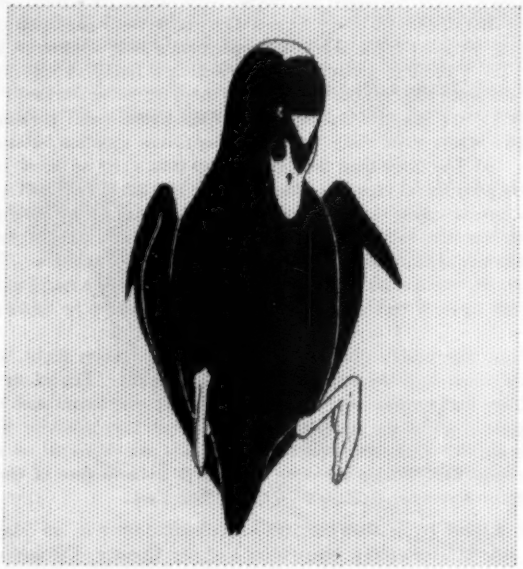


FIGURE 1. Surf Scoter rising to surface of water.

Observations by Stettenheim (field notes) and others indicate that Surf Scoters and White-winged Scoters (*Melanitta deglandi*) often submerge without extending the wings at all. It is not known whether in such cases the wings are used after the bird has submerged. When diving without use of the wings a Surf Scoter will sometimes clear the surface of the water in a high arc and disappear beneath the surface, propelled by the feet alone.

On December 30, 1953, at the Municipal Wharf, Monterey Bay, California, I observed the underwater activities of diving Surf Scoters. The water was deep (exact depth unknown) and the birds could be seen to a depth of about ten feet, where they passed out of sight. The diving Surf Scoters held the neck completely outstretched while descending towards the bottom; the wings were extended and sharply flexed at the wrists so that the wingtips were directed backwards. Although

the wingtips were near the rump, they had complete freedom of movement and were not pressed to the rump. The alula was plainly seen; it was extended laterally, away from the manus. Propulsion during descent was supplied by the feet and the wings, which moved synchronously, the downstroke of the wings and the propulsive stroke of the feet occurring together. The wings and feet moved together in steady, measured strokes with no pauses between them. The wings moved up and down (that is, dorsal to ventral, ventral to dorsal) steadily, instead of being pulled against the body to give a jet-like forcing of water backwards. The wing movements appeared to be underwater flying movements. The birds dove either straight down or at a slight angle from the vertical.

Brooks (Auk, 62: 520–521, 1945), describing the underwater activities of the White-winged Scoter (which, he says, dives in the same manner as the Surf Scoter), states that "the wings are flipped forward as the bird plunges, but under water the tips of the primaries can be seen crossed over the tail . . . the alula is extended to its utmost, giving the appearance of small, sharp-pointed wings held out rigidly on each side during the whole period of the dive. . . . No definite movement of the wings can be seen when the bird is submerged. As in all the diving ducks the feet appear as huge paddles with a decided lateral action. . . . To show how dangerous it is to be positive as to the invariability of any action, an adult female of this species always dived with her wings tightly closed and covered by the flank feathers; her mate just as invariably employed the above detailed action."

Forbush (Birds of Massachusetts and other New England states, vol. 1: 279, 1925) describes the underwater actions of a Surf Scoter as follows: "the wings were held about one-third spread and perfectly rigid. Used as planes or rudders they held the bird under water and on its course while the feet drove it onward. Both feet were used at once with powerful strokes."

Comments on the Common (or American) Scoter (*Melanitta nigra*) by Brooks (*op cit.*, 522), Marples (Brit. Birds, 23: 45, 1929), and Townsend (Auk, 26: 241, 1909) indicate that its diving habits are probably as variable as those of the Surf and White-winged scoters. Although more observations are needed, it seems clear that scoters can dive in any of the following ways: 1) using the feet only, 2) using the feet for propulsion and half-extended motionless wings for "planes or rudders," 3) using both feet and half-extended wings for propulsion. Whether these different methods of diving are merely individual differences as Brooks' observations suggest, or whether they are triggered by different environmental conditions, remains to be determined.

Surf Scoters returning to the surface of the water after dives were lifted by their own buoyancy. I made many observations of this behavior at the Municipal Wharf, Monterey Bay, California. During the ascent of a Surf Scoter to the surface of the water, the wings and feet were motionless and the head was held with the tip of the bill close to the breast. The wings were slightly extended and sharply flexed at the wrist; the alula was extended more or less laterally. The toes were together and flexed against the tarsus. The tarsus was directed antero-ventrally and laterally, flexed against the tibiotarsus (see Figure 1). The back of the bird's head was the first part to reach the surface of the water. As the scoter broke the surface of the water, it fell forward, the head was elevated from its position on the breast, and the bird resumed its natural position resting on the surface of the water. The position of the wings and feet prepared the bird for another dive immediately on reaching the surface of the water.

The path of a Surf Scoter returning to the surface of the water was often vertical

or at a slight angle from the vertical. Sometimes, however, I have seen them return to the surface on a spiral course, the bird's body rotating around its long axis. At no time, however, did I see any movement of the appendages during the ascent. I am grateful to Richard L. Zusi for drawing the accompanying figure from my field sketch.—PHILIP S. HUMPHREY, *Peabody Museum of Natural History, Yale University, New Haven, Connecticut.*

Food of the Black Skimmer (*Rynchops nigra*).—A. H. Howell, whose finds are based on Biological Survey examinations of stomachs, states that "skimmers apparently feed wholly on fish" (Florida Bird Life, Fla. Dept. Game and Fresh Water Fish, 1932, p. 275). E. H. Forbush (Birds of Massachusetts, Mass. Dept. Agr., Vol. I, 1929, p. 134.) states that they feed on fish and shrimp. I. T. Tomkins (Auk, 68: 236–239, 1951), in an excellent note on method of feeding, agrees with the latter, as do others who have observed the birds in their nesting colonies. The following observation indicates that shrimp are an important item in the diet of adult birds at other times than during the nesting season.

In the course of other investigations, ten Black Skimmers (*Rynchops nigra nigra*) were sacrificed. These birds were killed on the nights of February 3, 4, and 5, 1954, at Merritts Island, Brevard County, Florida. They had been observed skimming over the water in a shallow brackish lagoon in the late afternoon, the lower mandible cutting the surface of the water as is their habit. Examination of these ten digestive tracts revealed that six contained both fish and shrimp, while four contained only fish. Digestion was in most cases so far advanced that specific identification of the fish was not possible; however, one large needlefish (*Tylosurus* sp.), several *Lutjanus* sp., and several *Fundulus* type minnows were present. All shrimp that were identifiable were *Palaemonetes* sp. The largest number of whole fish in any one stomach was ten; they varied from 21 mm. to 55 mm. in length. Several of the large minnows had apparently been severed into two pieces. Sand was present in only one gizzard, but all contained fish scales in two instances a clean mass, all other organic material having been digested. A filamentous green alga was present in significant amounts in two birds; however, this may have been unavoidably ingested with animal food.

I am indebted to W. L. Jennings of the Fla. Game and Freshwater Fish Commission for aid in making these specimens available.—B. B. LEAVITT, *Department of Biology, University of Florida, Gainesville, Florida.*

The Gray Lag-Goose in Massachusetts: Correction.—The Gray Lag-Goose (*Anser anser*) was recorded from Massachusetts by S. Morris Pell (Auk, 50: 208–209, 1933), with details of its capture December 2, 1932, on the ice of the Housatonic River.

Later Mr. Pell became convinced that the bird had escaped from captivity, since it could not fly and was too heavy for a wild bird. This was also the opinion of Bartlett Hendricks, who saw the bird, examined the skin, and obtained this information.

This correction is being published at the suggestion of Dr. Alexander Wetmore.—DOROTHY E. SNYDER, *Peabody Museum, Salem, Massachusetts.*

REVIEWS

A Comparison of Bird Populations upon "Industrial" and "Rural" Farmland in South Wales.—Bruce Campbell. Cardiff Naturalists' Society's Reports and Transactions, 81: 4–65, 1950–1952.—This publication, a shortened version of a doctoral thesis, represents a great deal of careful, conscientious effort. It is well thought-through and well organized; it is presented with clarity and preciseness. Its central theme, not to mention various of its facets, is marked by originality in that the author selected a type of problem which had not been investigated before. To use Campbell's words—"it can be stated with some confidence that no previous comparison between the bird populations of farmland in close proximity to industrial development (. . . 'industrial farmland') and of farmland in a rural environment (. . . 'rural farmland') has been attempted in Britain; nor can any reference to such study elsewhere be found in the accessible literature."

The study opens with rather full descriptions of the general setting of the problem, including, among other features, a review of the literature on bird population studies and an account of the industrialization of South Wales. The author's field work, which began in 1944–45 and carried through 1945–46 and 1946–47, involved considerable areas (shown by a map) in the eastern part of the South Wales coalfield. The methods used in estimating populations of birds are set forth and are subjected to critical discussion. Both the breeding and winter populations were estimated in selected study areas or sample blocks, each being 100 acres in extent. Four blocks were located in industrial farmland (A^i, B^i, C^i, D^i) and four others, serving as controls, were located in rural farmland (A^r, B^r, C^r, D^r). The "^{r}" blocks represented four types of farmland at different altitudes (each including a farmhouse and its surrounding buildings); suitable control blocks, with freedom from industrial influence being the main variable, were found albeit with some difficulty. Censuses of breeding populations were taken by essentially the same procedure that is followed by contributors to *Audubon Field Notes*. Winter-bird counts were somewhat less accurate and pertained to "visible populations," for which average figures were based on data gathered during at least eight visits or coverages (between late October and early April). Summaries of densities (arranged by year, block-designation, species, and family-group) based on breeding-bird censuses, expressed as number of pairs per block, and winter counts, expressed as number of individuals per block, are furnished in extensive tables.

Let us single out a few of Campbell's findings. From breeding-census data it was determined that "^{r}" populations were greater than "^{i}" in 1946 but that this tended to be reversed in 1947 after a period of severe weather. Considering all species (residents and summer visitors), the grand averages for 1946 and 1947 were 80.0 pairs per 100 acres in "^{i}" blocks and 100.5 pairs per 100 acres in "^{r}" blocks. In both "^{i}" and "^{r}" the two commonest nesting species were the Chaffinch and Blackbird. The author states that "it is likely that fewer species breed on industrial than on rural farmland." This difference is due in large part to a group of "highly tolerant or adaptive species" which concentrate around farmhouses in rural areas but prefer to breed in and about man-made constructions surrounding the farmlands of industrial areas. Some important species among these tolerant "habitation associates" are the Jackdaw, Starling, House Sparrow, Pied Wagtail, Swallow, and House Martin. Other analyses relative to the breeding populations are furnished with a view to determining whether any other industrial effects are apparent. Nesting dates tend to be the same on "^{i}" and "^{r}," and quantitative information on nesting failure in two common species shows very little difference between the two types of farmland.

To quote from the author's summary (p. 59): "Species intolerant of industrial conditions in South Wales are Jay, Chaffinch (to some extent only) and Yellow Bunting in the breeding season; Rook, the scarcer tits and warblers, Wood-Pigeon, riparian birds, water-fowl, waders and game-birds at all times."

The results of winter counts reveal that mean populations are about the same in industrial and rural farmland. For the two types of habitat the grand averages are, respectively, approximately 268 and 260 birds per block. The areas "i" and "r" are also closely similar not only with respect to monthly averages but with respect to most family-groups; however, an excess of Rooks (Corvidae) occurs on "r" and an excess of Starlings (Sturnidae) and House Sparrows (Ploceidae) on "i." The last-mentioned species tend to balance the Rooks numerically. Twenty-six species are categorized in terms of frequency of occurrence. The highest category, referring to birds occurring in at least six counts in every block, includes the Chaffinch, Blackbird, Magpie, Blue Tit, Robin, and several other species.

A short account of winter-bird biomass, which appears to be greater on the rural farmland, ought to be stimulating to British and American workers alike. To say that this phase of avian ecology has been rather neglected in both countries is to understate the case. The author's calculations show the weights of mean winter populations on "i" and "r" to be about 24.6 and 31.2 kilograms, respectively. In both areas the Corvidae contribute more to the population weight than any of the other families. Because of their favoring rural environments, Rooks alone account for a considerable part of the difference in biomass between the two sorts of farmland.

There are other analyses. For example, "in some closely related species, Fieldfare and Redwing, Great Tit and Blue Tit, a different [abundance] ratio according to altitude is probable." Such statements as this (often supported by data that seem plentiful) are illustrative of the care and caution with which Campbell summarizes his findings and shapes his conclusions. In general the analyses and comparisons embodied in this study are thoroughgoing and devoid of loose ends. It is true that the statistically-minded reader might here and there look for something more. He might, for instance, look for a comparison of data from "i" and "r" blocks in terms of coefficient of community or some analagous measurement (cf. Bray, Ecology, 37: 21–28, 1956). Such refinements would, however, result in but slight enhancement of the value of the study. Surely they would not alter substantially any of the author's conclusions.

Information from the literature together with Campbell's data indicates that the status of many of the commoner species in the region in question "appears to have been relatively stable for possibly fifty years." Even so, this general conclusion is reached: "There has been an impoverishment in the bird population, especially in the remaining semi-natural habitats, due to the industrialization of the South Wales coalfield." The reviewer can add only this: There has been an improvement, an enrichment, in the nature of bird-population studies, especially those conducted in farmlands of South Wales coalfields, due to the industry and scholarship of Bruce Campbell.—Robert A. Norris.

Natural History of Birds.—Leonard W. Wing. New York, Ronald Press Co., xi + 539 pp., 1956. Price, $6.75.—According to the preface, "this book was written for people interested in birds wherever found or studied—whether in classroom, laboratory, library, garden, woods, or field." The form is that of a classroom text, and as Wallace's "Introduction to Ornithology" is the only other one available the present book is sure to be widely considered for such use. While Wallace's

work is avowedly aimed at the beginning student, Wing's book is more ambitious and seems intended for both beginners and advanced students as well as for the general reader.

This book is a large one, and it ranges over the entire field of ornithology in varying amounts of detail. There are 24 chapters, each with selected references, an 18-page bibliography, a glossary, an index, and lists of leading periodicals, official state birds, and the avian orders and families (Wetmore's 1951 arrangement). There are numerous illustrations. Topics discussed include systematics, anatomy, embryology, physiology, evolution and genetics, ecology, behavior, song, distribution, migration, conservation, and economics. This breadth of subject is commendable, and there is much material that one is not likely to encounter outside of the professional journals. The author has undertaken a difficult task in trying to encompass all this and to present it for readers of various backgrounds. Be that as it may, a work intended for students and for use as a general reference should maintain the highest possible standards in disciplined use of language, inclusion of recent advances in knowledge, adequate explanation of pertinent material, and accuracy in statements of fact. In short, it should meet the tests of a work of scholarship, and I have tried to evaluate the book in terms of these criteria.

Although this book has many virtues, including its scope, the abundance of illustrations, and the wide variety of references that it brings together, I find the quality of the writing to be largely unsatisfactory. The book not only lacks a smoothly-flowing style, but the writing is loosely-organized, rambling, and often ambiguous, tautological, and redundant. Consider the following examples: "It seems clear enough, even with the scanty information available through the fossil record, that the bird of the Mesozoic was indeed a bird. Hence, we may conclude that any further development would be more properly the evolution of the bird rather than its origin. The study of birds from the Mesozoic onward becomes the study of creatures already birds. The birds of the Mesozoic may therefore be considered as true birds . . ." (p. 13). "Generally speaking, the over-all range of birds forms a continuous one with but scattered pockets beyond the main limits." (p. 190). "The sex of birds having marked sexual dichromatism (or other sexual dimorphism) often may be recognized by appearance." (p. 347). "Because some characters are sex-linked, the gene for that character is carried by the sex chromosomes." (p. 393).

The quotations above are not isolated examples; similar ones may be found in virtually all sections of the book. It may be that awkward constructions are inevitable in a text and that they are not important if the facts are there and the meaning can be made out. But consider the following passages from the section on the avian nervous system: "The nervous system as a whole consists of sensory organs and the *central* and *sympathetic* (*involuntary*) nervous systems. . . . The great sense organs of sight and hearing and the seat of many other mental faculties are located in the brain." (pp. 72–73). Apart from the serious confusion over the major divisions of the nervous system, the eye and ear are unequivocally stated to be in the brain. Of course the author does not actually mean this, but surely he should take the trouble not to say it. There is more of the same on p. 75, where it is stated that "The spinal nerves . . . are part of a complex organization through which the heart, lungs, digestive tract, blood vessels, and many other parts of the body are controlled 'involuntarily.'" This passage continues the complete confusion of the spinal nerves with the autonomic fibers, which may of course run in either spinal nerves or cranial nerves such as the vagus. Some of the functions of the

vagus are in fact listed in a table on p. 74, but in this the 11th cranial nerve is erroneously said to control the heart. In these paragraphs, and in other less important ones, the facts are not presented correctly and the meaning is misleading. For additional examples, see pp. 63–65 (digestion), p. 69 (exchanges between blood and tissues), the portal systems (see below), and many others.

Teleological phrasing is used frequently throughout the book. Here are some examples in which natural events are explained in terms of purpose: "Scavenger birds . . . usually have bare heads, perhaps because plumage on the head tends to become excessively 'soiled' in the Vulturine way of life." (p. 46). "Wading birds have the legs lengthened in order to hold the body above the water. As a compensation, the neck has lengthened so that the bill will still reach the ground." (p. 48). "The *winnowing* of the Snipe . . . is caused by air vibrating the outer tail feathers especially developed for this purpose." (p. 326). Now, one may remark in casual conversation that birds evolved wings so that they could fly, but it is another matter to put such phraseology into a text. Pursued to its logical conclusion teleology leads to a vitalist position, and unless an author intends this I feel that special efforts should be made to avoid it. A naive reader would certainly be led to believe that unexplained forces act directly on the bird and cause development of structures specific for its needs.

In my opinion, the attempt to reach readers of all levels of background results all too frequently in compromises that will satisfy neither the beginner nor the advanced reader. On p. 13, we are told that "Biologists recognize two major divisions of living things and have designated them as the PLANT KINGDOM and the ANIMAL KINGDOM." On p. 51, one reads that "the skeleton acts as an internal framework or scaffolding, somewhat as a steel frame reinforces and supports the masonry, brick work, and trim of a skyscraper." These statements are clearly intended for readers at the most elementary level, but such introductory remarks are often followed by a discussion that is surely too complex for the beginner, including uses of technical terms that are not defined precisely, if at all (see later comments on the glossary). This mixed approach is best exemplified by the discussion of circulation: "The circulatory system in the bird consists primarily of the *lymph apparatus*, and the *heart, arteries, veins* [what about capillaries?], and *blood* (Fig. 4–15). The circulatory system follows the higher reptilian pattern, but the postcaval vein connects directly to the renal portal system." (p. 68). The reader who needs to be told what the circulatory system consists of (and it is told rather poorly) will have no idea of what is meant by the higher reptilian pattern, the postcaval vein, or a portal system. The text figures referred to do not label these things, and unhappily the captions are transposed. The reader in search of a definition of a portal system gets the following: "The part of the venous system operative in the viscera, particularly in returning the blood through the great liver, is the *hepatic portal system*. That gathering blood from the lower limbs is the *renal portal system*, and the whole is called the *systemic venous system*." (p. 69). The kidneys are completely left out, and there is never any mention of the capillary bed lying between two sets of veins that is the distinguishing feature of a portal system. Many additional examples could be cited; for a lesser one, see the treatment of the endocrine system on pp. 71–72.

In other instances, there are inadequate explanations that seem to be the result of haste or carelessness. Of many possible examples, consider this one on p. 13: "A bird fossil described as *Ichthyornis* from the Cretaceous marine deposits of Kansas (on the basis of an incomplete skeleton) has been shown to have had a jaw agreeing

with the jaw of mosasaurs. It is concluded that the jaw found with the fossil was not that of a bird (Gregory, 1952)." This is not only a self-contradictory passage, but there is no mention (here or elsewhere) of the important point that *Ichthyornis* was long thought to be a toothed bird, that this belief was based entirely on the presence of teeth in the associated lower jaw, that mosasaurs were contemporaneous marine reptiles, and that the removal of *Ichthyornis* from the Odontognathae is a major revision in paleornithology. A reference to Gregory's paper is given, to be sure, but the reader who does not look this up or who lacks ready access to the journal is left uninformed.

There are many instances in which a provocative or debatable point is raised but not fully discussed. Some are merely curious. On p. 127, it is said that "The three nonvisual values [of color] are absorption of light or heat rays, reflection of these waves, and the deposition of excretory products." The first two values are discussed adequately, but the third, which is most in need of clarification, is never mentioned again. Other examples are subject to more serious criticism. On p. 149, we read: "But a fundamental weakness (and to some nongeneticists an insurmountable flaw) in the evolution-by-mutation concept is the field and laboratory evidence that mutations are well-nigh universally of a weakening nature adversely affecting vigor (page 395)." Is the author among those "nongeneticists"? We are not told. In any case, this evident rejection of a fundamental tenet of modern evolutionary theory fairly cries for explanation. If not evolution by mutation, then by what? The author does not give the slightest indication of what his alternative interpretation, if any, may be. The reference on p. 395 only points out examples of color abnormalities and other anomalies that are maladaptive. The point is not that the concept of evolutionary change through mutation is too sacred to challenge, but that we are entitled to an adequate explanation for its rejection and to a reasonable hypothesis to replace it.

A long list of less important controversial statements could be compiled. "The fossil record testifies to the principle of *racial senescence*." (p. 155); this seems to be contradicted, however, on p. 165. The picture of fierce competition between birds and pterosaurs evoked on pp. 161–162 is questionable on both chronological and paleoecological grounds, and the author indicates as much in an afterthought at the end of the discussion. The use of vernacular names for subspecies, as in the section on scientific nomenclature (pp. 29–30), is also open to question.

The book is reasonably successful with regard to inclusion of recent advances in research. There are even some 1956 references, including a useful illustration (p. 145). However, there are a few omissions, some of them minor, that need to be mentioned. The old explanation that barred feather patterns are caused by changes in blood pressure and mitotic activity at night (p. 116) is surely rendered obsolete by more recent experimental work (see Rawles, M. E., Physiol. Rev., **28:** 383–408, 1948, for a review). More information on photoperiodism in relation to breeding cycles than is given in the brief paragraph on p. 91 would be welcome, especially since nothing on recent work on the significance of interruptions of the dark period is included. Farner's excellent review on the annual stimulus for migration (Condor, **52:** 104–122, 1950) is not cited. De Beer's monograph (1954) on *Archaeopteryx* is not mentioned, and this is especially unfortunate in view of Wing's discussion of this important fossil: "The upper arm muscles apparently were large and powerful, though the hand muscles were almost nonexistent, while those of the lower limbs were much reduced and rather weak as in modern birds. The flight muscles (pectoral) were evidently highly developed and massive in order to

operate the arm . . ." (p. 12). Apart from De Beer's work, more accurate information than this is available in many publications on the Jurassic bird fossils, and the author himself partly contradicts the above assertions on p. 268.

The illustrations are numerous, as they should be, and this is a commendable feature of the book. Some of them are outstanding, especially the muscle drawings from Hudson's papers and the anatomical diagrams of Beecher. However, the original figures prepared for this book do not always measure up to the quality of the reproduced illustrations. Many of the former are quite amateurish and were possibly prepared in haste; the drawings in the chapter on plumage (pp. 113–132) are a case in point. Captions are occasionally transposed (pp. 68, 128) or are inadequate to explain the illustration (p. 116), or are evidently omitted (p. 43). There is some duplication in the text figures that could have been eliminated in the interest of economy or replaced by such things as illustrations of the internal anatomy of the syrinx, diagrams to supplement the discussion of genetics, or maps of biotic provinces and biomes.

Editorial and typographical errors are too numerous to list in full, but a few of the more obvious ones should be mentioned. "Ovums" (p. 395) and "caecums" (used repeatedly) are given as plural forms instead of ova and caeca, and "apteria" and "apterias" are both used as plurals (pp. 113–114). *The Catalogue of the Birds of the Americas* has been complete since 1949, but its date of publication is given as (1918—) and Conover is not mentioned as one of the authors. The class name of leeches is spelled Hirundinea (which would refer to swallows) instead of Hirudinea (p. 404). Pearson's calculation of the non-stop flight range of the Ruby-throated Hummingbird is quoted as 835 miles (p. 307) instead of 385, which destroys his point that this species probably could not fly 500 miles across the Gulf of Mexico (since shown possible by additional data of Odum and Connell [Science, **123:** 892–894, 1956]).

Turning to the glossary, it is discouraging to find the same type of carelessness that was discussed earlier in this review. A glossary should provide definitions that are concise, accurate, and meaningful, but far too many in the present one do not meet these standards. Some are hardly useful at all (Pharyngeal gills: gills located in the pharynx; Aorta: a large artery, usually one connected to the heart), others are variously inadequate (Isolation: the separation of groups by which taxonomic differences may arise; Species: a population of birds reproductively isolated), and some are simply erroneous (Columella: a bone of the inner [*sic*] ear; Oxygen debt: use of oxygen stored chemically; Homozygous: having both genes of a pair either recessive or dominant), right down to the last entry (Zygodactyly: "yolk-toed" [*sic*] condition, as in the Kingfisher [*sic*]). When a glossary provides definitions like this, the reader will do better to ignore it and consult the index instead—in which case the glossary need not have been included.

The documentation and discussion of many adverse criticisms leaves me little space for favorable comments. Some of the good features of the book have already been mentioned, and I found much to admire in the chapters on ecological relations, territory, behavior, flight, migration, song, courtship and nesting, and conservation. But in virtually every chapter, including those just listed, there were numerous matters of style, organization, or content with which I could not agree. In my notes for this review I find over 120 points of criticism of the sort that I have discussed previously, and this figure does not include typographical errors or disagreements with the glossary. A more discerning critic could doubtless find many additional examples, for troublesome points arose in the most unexpected places. In

the section on bird protection, for instance, where there is much good material, one finds the following statement: "Interest in nature as a form of enjoyment is a characteristic of the British, Teutonic, and Scandinavian cultures. It is less apparent in Latin, Slavic, Oriental, and other cultures. The underlying motives for this would surely be a fruitful source of philosophical inquiry." (p. 416). To say that this is a dubious assertion is to put it mildly, and further comment can best be left to members of the allegedly less appreciative societies.

In reviewing this work, I have assumed that students of ornithology are entitled to texts that maintain the same standards of accuracy and intellectual discipline that are demanded as a matter of course in other, less "popular," sciences. This book is the only attempt at a comprehensive text on birds that is available in the English language, and many people here and abroad may assume that it is an authoritative representation of the status of ornithological knowledge in America. I feel, therefore, that special responsibilities are inherent in a work of this kind. The final authority on whether or not a book measures up to its responsibilities is not the reviewer, of course, but the book itself. This one should be carefully examined and evaluated by everyone with a serious interest in ornithology.—THOMAS R. HOWELL.

The Birds of the Soviet Union.—Edited by G. P. Dementiev and N. A. Gladkov. (State Publishers, "Soviet Science," Moscow, 1951–1954.) 6 volumes. (In Russian.)—This important work is reviewed and summarized by Harber in 'British Birds,' 48: 218–224, 268–276, 313–319, 343–348, 404–410, 447–453, and 505–511, 1955. We can do no better than to refer our readers to this useful review and to add that even for those of us who cannot read Russian, the distribution maps will prove useful.—R. W. S.

RECENT LITERATURE

EDITED BY FRANK McKINNEY

ANATOMY AND EMBRYOLOGY

BERGER, A. J. 1956. Anatomical variation and avian anatomy. Condor, **58:** 433–441.—Attention is drawn to the fact that anatomical variations are the rule instead of the exception. Especially is this indicated in avian nerves, bones, and blood vascular system. Anatomists are cautioned against generalizations on a "typical" pattern because variations are to be expected.—D. W. J.

BLAKE, C. H. 1954. Gape color in Eastern Purple Finches (*Carpodacus p. purpureus*). Bird Banding, **25:** 133–136.

FRAZER, R. C. 1957. Somite genesis in the chick. I. Partial characterization of stimulating factors in egg white. Growth, **21:** 29–43.

HANKE, B. 1957. Zur Histologie des Ösophagus der Tinamidae. Bonner Zool. Beitr., **8:** 1–4.—The histology of the esophagus of *Crypturellus obsoletus* and *Tinamus major*.

STORER, R. W. 1956. The fossil loon, Colymboides minutus. Condor, **58:** 413–426.—Through this exhaustive osteological study comparing *Colymboides* with recent loons and grebes, the conclusion is drawn that *Colymboides* was a primitive loon which reached an adaptive level comparable to that of grebes. It is further concluded that loons and grebes did not arise from a common swimming ancestor, but that loons were derived from a primitive larine ancestor and evolved a diving habit.—D. W. J.

WELLER, M. W. 1957. Growth, weights, and plumages of the Redhead, *Aythya americana*. Wilson Bull., **69**: 5–38.—Described are the growth of young Redheads, the seasonal weight changes and sexual weight differences of adults, and the sequences of plumage and molts for each sex. Studies were made of both hatchery-reared and wild-reared birds. Illustrations include a color plate.—J. T. T.

BEHAVIOR

ALTEVOGT, R. 1953. Über das "Schöpfen" einiger Vogelarten. Behaviour, **6**: 147–152.—(From English summary). Thread-pulling behavior developed about 12 days after fledging in *Parus caeruleus*. The foot and bill movements used in feeding may lead to thread-pulling and there is no need to imply that "insight" is used.—F. M.

ANDREW, R. J. 1957. A comparative study of the calls of *Emberiza* spp. (buntings). Ibis, **99**: 27–42.—Information on wild and/or captive *Emberiza citrinella*, *E. calandra*, *E. schoeniclus*, *E. cirlus*, *E. cia*, *E. hortulana*, *E. tahapisi*, *E. bruniceps*, *Calcarius lapponicus*, and *Plectrophenax nivalis* is presented. A great variety of calls is analyzed using the sound spectrograph. Homologies in the calls are detected and are used in part to establish degrees of relationship among buntings. *E. cirlus* and *E. citrinella* seem closely related as do *Calcarius* and *Plectrophenax*.—R. F. J.

BAGGERMAN, B., G. P. BAERENDS, H. S. HEIKENS, and J. H. MOOK. 1956. Observations on the behaviour of the Black Tern, *Chlidonias n. niger* (L.), in the breeding area. Ardea, **44**: 1–71.—This fine paper represents the culmination of seven seasons of observation in three different colonies in the Netherlands. A condensed life history is given. Reproductive activities are described and the derivation of each is discussed. An analysis is given of the biological significance of those activities having a signal function. Comparisons with activities of other larids are made throughout.—R. E. G.

BASTOCK, M., D. MORRIS, and M. MOYNIHAN. 1953. Some comments on conflict and thwarting in animals. Behaviour, **6**: 66–84.—A valuable discussion of certain ethological concepts. Special attention is given to displacement activities. "Redirection Activities" occur when an animal is under the influence of conflicting drives and "the executive motor patterns of one of the activated, conflicting drives are transferred onto another external object."—F. M.

FRISCH, O. VON. 1956. Zur Brutbiologie und Jugendentwicklung des Brachvogels (*Numenius arquata* L.). Zeitschrift für Tierpsychologie, **13**: 50–81.—An excellent life history study which includes much on the behavior of this species. The behavior is compared to that of other waders.—W. C. D.

GOODWIN, D. 1956. Observations on the voice and some displays of certain pigeons. Avic. Mag., **62**: 17–33, 63–70.—The comparative behavior of several species of pigeons, mostly *Streptopelia* and *Columba*, is discussed. This is illustrated by drawings and concluded with a discussion of the phylogeny of the forms treated.—W. C. D.

HARRISON, C. J. O. 1956. Some Fire-Finches and their behaviour. Avic. Mag., **62**: 128–141.—Observations on the comparative behavior of three species of Fire-Finches are given (*Estrilda senegala*, *E. caerulescens*, and *E. rufopicta*). These observations are based on birds breeding in captivity and are accompanied by drawings of some of the displays observed.—W. C. D.

HAUSER, D. C. 1957. Some observations on sun-bathing in birds. Wilson Bull., **69**: 78–90.—Normal sun-bathing behavior of several species is described.

An exaggerated behavior occurs when a bird is exposed to bright sun and high temperatures; its possible adaptive value for rapid cooling is discussed.—J. T. T.

HULME, D. C. 1955. Buildings as Song-posts. British Birds, **48:** 211–215.—Of nine species only the Starling (*Sturnus vulgaris*) showed a preference for song-posts situated on buildings.—M. T. M.

HUMPHREY, P. S. 1957. Remarks on the courtship and voice of the Black Scoter. Condor, **59:** 139–140.

KLUYVER, H. N. 1955. Das Verhalten des Drosselrohrsängers, *Acrocephalus arundinaceus* (L.), am Brutplatz mit besonderer Berücksichtigung der Nestbautechnik und Revierbehauptung. Ardea, **43:** 1–50.—This is a thorough account of the behavior of the Great Reed Warbler with special emphasis on the nest building and territorial defense. Some males hold territories in vegetation unsuitable for nest building. The nest material is dipped in water by the females to render it flexible and more adherent. Nest cup is molded by a characteristic trampling movement of the legs (scraping). The nest rim is raised, not by scraping, but by use of the bill.—W. C. D.

MANVILLE, R. H. 1957. Effects of unusual spring weather on Scarlet Tanagers. Wilson Bull., **69:** 111–112.—After a killing frost in late May in southern New York State, many *Piranga erythromelas* in poor condition were observed feeding on and near the ground. With the return of warm weather, the tanagers resumed their usual feeding in tree tops.—J. T. T.

MORRIS, D. 1954. The courtship behaviour of the Cutthroat Finch (*Amadina fasciata*). Avic. Mag., **60:** 169–178.—A description of the courtship behavior of the Cutthroat Finch is given not only as a contribution to a better understanding of behavior but also as an illustration of the immense value of making detailed observations on the behavior of common aviary species.—W. C. D.

MORRIS, D. 1954. The reproductive behaviour of the Zebra Finch (*Poephila guttata*), with special reference to pseudofemale behaviour and displacement activities. Behaviour, **6:** 271–322.—Most disputes are settled by actual fighting. The pre-copulatory behavior of the male results from a conflict between fleeing and mating. Pseudofemale behavior of the male occurs in certain circumstances when the sex drive is thwarted. Occasionally reversed mountings occur. Displacement activities and many other aspects of reproductive behavior are described and discussed.—F. M.

MOYNIHAN, M. 1955. Some aspects of reproductive behaviour in the Black-headed Gull (*Larus ridibundus ridibundus* L.) and related species. Behaviour Supplement **4:** 1–201.—A detailed description and analysis of the hostile and sexual behavior patterns. Most attention is devoted to the aerial and ground displays which occur during the period of pair-formation and the causation of these displays is investigated in terms of conflicting attack, escape, and sex drives. The final section compares the displays of other Lari and discusses the classification of the group.—F. M.

NICOLAI, J. 1956. Zur Biologie und Ethologie des Gimpels (*Pyrrhula pyrrhula* L.). Zeitschrift für Tierpsychologie, **13:** 93–132.—This paper is the result of five years observation on the ecology and ethology of the bullfinch.—W. C. D.

WEIDMANN, U. 1955. Some reproductive activities of the Common Gull, *Larus canus* L. Ardea, **43:** 85–132.—This paper discusses and describes the interrelationships of the more or less incompatible tendencies of attack, escape, and sex along with the resultant displays. Comparison is made with other larids.—W. C. D.

WEIDMANN, U. 1956. Verhaltensstudien an der Stockente (*Anas platyrhynchos*

L.) I. Das Aktionssystem. Zeitschrift für Tierpsychologie, **13:** 208–271.—An exhaustive description of the fixed action patterns of the Mallard is given. Attention is paid to the activity periods, causal factors, biological significance, and evolution of these patterns.—W. C. D.

ZIMMERMAN, D. W. 1957. Some remarks on the behavior of the Yucatan Cactus Wren. Condor, **59:** 53–58.

DISEASES AND PARASITES

CORBET, G. B. 1956. The life-history and host-relations of a hippoboscid fly *Ornithomyia fringillina* Curtis. J. Anim. Ecol., **25:** 403–420.—Studies in England on 5 species of passerine birds.—S. C. K.

CORBET, G. B. 1956. The phoresy of mallophaga on a population of *Ornithomya fringillina* Curtis (Dipt., Hippoboscidae). Entomologist's Monthly Mag., **92:** 207–211.—A discussion of the possible transmission of bird lice by hippoboscid flies.—R. W. S.

OWEN, D. F., and J. S. ASH. 1955. Additional records of *Protocalliphora* (Diptera) in birds' nests. British Birds, **48:** 225–229.—Supplement to an earlier paper on this parasitic fly, found in both Europe and America. Nine new bird hosts are recorded.—M. T. M.

DISTRIBUTION

ANON. 1955. Lesser Yellowlegs in Britain, 1953–1954. British Birds, **48:** 363–366.—*Tringa flavipes* is becoming a regular American vagrant to the British Isles, 14 being recorded in 1953–1954.—M. T. M.

BERGSTROM, E. A. 1955. American Land-Birds in Western Europe. Letter. British Birds, **48:** 237–238.—Some species, normally regarded as sedentary do in fact migrate partially. Occurrences of such American species in Europe should be accepted as true cases of vagrancy, and not as artifacts.—M. T. M.

BOURNE, W. R. P. 1957. The breeding birds of Bermuda. Ibis, **99:** 94–105.—This is a systematic list of the breeding birds of the Bermudas and includes discussion of migrants, zoogeographic affinities, morphology, and behavior of residents, and the general avian ecology on the islands.—R. F. J.

CAMPBELL, M. 1955. Birds seen during a crossing of the North Atlantic, 16th–23rd October, 1954. British Birds, **48:** 208–210.

GULLION, G. W., and G. C. CHRISTENSEN. 1957. A review of the distribution of gallinaceous game birds in Nevada. Condor, **59:** 128–138.—Nevada distribution maps are given for Blue Grouse, Hungarian Partridge, Ring-necked Pheasant, Sharp-tailed Grouse, Sage Grouse, Chukar Partridge, Gambel Quail, California Quail, and Mountain Quail. A short discussion indicates suitable and unsuitable (i.e., occupied and unoccupied) habitats for these upland gallinaceous game birds. About 62 per cent of Nevada is not occupied permanently by any of these game birds.—D. W. J.

KENNEDY, P. G. 1955. Black Duck in Co. Kilkenny: A bird new to Ireland and Britain. British Birds, **48:** 341.—A female *Anas rubripes* taken in Ireland in February 1954 is the first European record of this species.—M. T. M.

KING, J. E., and R. L. PYLE. 1957. Observations on sea birds in the tropical Pacific. Condor, **59:** 27–39.—A report of birds seen on an 86-day, 13,800-mile cruise in the equatorial region of the eastern and central Pacific. Each day the number of scattered birds and number of birds in flocks were recorded. Scattered birds generally increased from west to east, being influenced by proximity to the Mexican coast and by rich zooplankton near 140° W. long. Scattered birds

seemed to be most numerous during the late afternoon; their frequency could not be correlated with temperature change at the surface. Forty species were recorded.—D. W. J.

LAMBERT, A. 1957. A specific check list of the birds of Greece. Ibis, **99:** 43–68.—All species occurring in Greece are listed with indications of their distributions, habitat preferences, and numbers. There is included a bibliography of Greek ornithology.—R. F. J.

NEFF, J. A., and B. MEANLEY. 1957. Status of Brewer's Blackbird on the Grand Prairie of eastern Arkansas. Wilson Bull., **69:** 102–105.—*Euphagus cyanocephalus* is a numerous winter visitor to this region, feeding largely on waste rice, grains, and grass seeds.—J. T. T.

PARKES, K. C. 1957. Notes, chiefly distributional, on some Florida birds. Wilson Bull., **69:** 106–107.—On 9 species.

ROBERT, H. C., J. M. TEAL, and E. P. ODUM. 1956. Summer birds of Sapelo Island, Georgia: a preliminary list. Oriole, **20:** 37–45.

SEAMAN, G. A. 1957. New bird records for Barbuda, British West Indies. Wilson Bull., **69:** 109–110.—8 species.

SHAUB, M. S. 1954. Summer appearances of adult and juvenal Evening Grosbeaks. Bird Banding, **25:** 87–95.—The increase of the Evening Grosbeak in New York, New England, and the Maritime Provinces is documented.—W. J. H.

SMITH, F. R. 1955. Myrtle Warbler in Devon: A New British Bird. British Birds, **48:** 204–207.—The first British specimen of *Dendroica coronata* (January and February, 1955).—M. T. M.

TAIBEL, A. M. 1955. Uccelli del Guatemala con speciale riguardo alla regione del Petén raccolti dal maggio al settembre 1932. Atti Soc. Ital. Sci. Nat. 94 (1): 15–84, pls. 2–8.—Report on a collection of 244 skins including 111 forms secured during an expedition to obtain living Ocellated Turkeys for experimental breeding. The report covers 87 forms collected in Petén, 11 taken at Lake Amatitlán and San José, and 13 from Alto Vera Paz purchased from a taxodermist. *Richmondena cardinalis petenensis* is described from the forest area at Lake Petén-Itzá.—A. Wetmore.

ECOLOGY

BOYD, H. 1956. Statistics of the British population of the pink-footed goose. J. Anim. Ecol., **25:** 253–273.—Estimates of adult death-rates from recoveries of marked birds. Size of British population estimated by capture-recapture method at 40–50,000. Ratio of sexes is equal. Most individuals breed when 32 months old. Mean clutch size is 4.5.—S. C. K.

JOHNSGARD, P. A., and W. H. RICKARD. 1957. The relation of spring bird distribution to a vegetation mosaic in southeastern Washington. Ecol., **38:** 171–174.—Between March and June, the shrubby *Symphoricarpos-Festuca* community was used 30 times more than the grassy *Agropyron-Poa* community.—S. C. K.

KLOMP, H. 1954. De terreinkeus van de Kievit, *Vanellus vanellus* (L.). Ardea, **42:** 1–139.—This study is an analysis of the factors governing the distribution of breeding Lapwings in the northern and western districts of the Netherlands. The paper includes such topics as habitat selection, survival value of habitat preferences, and an analysis of the terrestrial locomotion of the Lapwing and the Godwit. This latter subject is treated from the standpoint of the adaptive values of certain limb lengths and proportions.—W. C. D.

LACK, D. 1956. Variations in the reproductive rate of birds. Proc. Royal Soc., B. **145:** 329–333.—In swifts, the European Blackbird, and tits "the average

clutch varies with the time of year, in different years, with habitat and with age." These variations seem to be adaptive and presumably natural selection has acted against a rigidly fixed clutch size.—F. M.

LEGG, K., and F. A. PITELKA. 1956. Ecologic overlap of Allen and Anna hummingbirds nesting at Santa Cruz, California. Condor, **58:** 393–405.—In 1954 and 1955 overlapping breeding populations of these two hummers were studied with special emphasis on interspecific competition. In several instances of competition for territories, Allen Hummers usually displaced Anna. Supporting these studies were rather detailed reports of 44 nests (23 of Anna and 21 of Allen) on the study area of six acres.—D. W. J.

LOCKIE, J. D. 1956. The food and feeding behaviour of the jackdaw, rook and carrion crow. J. Anim. Ecol., **25:** 421–428.—Analysis and description of food niches.—S. C. K.

MACARTHUR, R. H. 1957. On the relative abundance of bird species. Proc. Nat. Acad. Sci., **43:** 293–295.—After examination through mathematical formulae of the three hypotheses, (1) Nonoverlapping Niches, (2) Overlapping Niches, (3) Niches Particulate, Not Continuous, the conclusion is reached that the first coincides most closely to field observations. It is suggested "that, at least as a rough approximation, niches do not overlap much and are more continuous than discrete."

WEBSTER, J. D. 1957. Birds and grasslands in western Mexico. Hanover [Indiana] Forum, **3** (1): 34–45.

General Biology

BETTS, M. M. 1956. A list of insects taken by titmice in the Forest of Dean (Gloucestershire). Entomologist's Monthly Mag., **92:** 68–71.

CROWE, R. W. 1955. Parental Care in the Whitethroat. British Birds, **48:** 254–260.—Detailed observations of the time spent by each sex in incubation, brooding, and feeding in the warbler, *Sylvia communis*. Nest relief behavior is described, as is the apparent synchronization, by neighboring males, of their periods on the nest.—M. T. M.

CUTCLIFFE, A. S. 1955. Further Notes on the Swift, 1944–1954. British Birds, **48:** 193–203.—Report on a ten-year study of *Apus apus* in Devon. There are discussions of non-breeding birds, homing, bad-weather movements, simulated coition in flight (as opposed to actual coition on the nest), and of the hippoboscid fly *Crataerina pallida* (Latr.) and other parasites. No nestlings banded in the tower returned to it as adults. 1954 was a really bad breeding season in Devon, as it was at Oxford, and no nestlings survived.—M. T. M.

EVENDEN, F. G. 1957. Observations on nesting behavior of the House Finch. Condor, **59:** 112–117.—This is a report of 48 nesting attempts studied from 1950–1954. Subjects covered include nest sites, egg laying, incubation, hatching, nestlings, double nestings, and nest mortality.—D. W. J.

HANSON, H. C., and C. W. KOSSACK. 1957. Methods and criteria for aging incubated eggs and nestlings of the Mourning Dove. Wilson Bull., **69:** 91–101.—Descriptions and illustrations of the stages of *Zenaidura macroura*.—J. T. T.

HOWELL, T. R. 1957. Birds of a second-growth rain forest area of Nicaragua. Condor, **59:** 73–111.—The present paper is based upon collections and observations during parts of two years. The annotated list variously treats of habitats, measurements and colors of specimens, breeding, and subspecific characters. There is a discussion relating to the disappearance of certain birds as the primeval forest is altered.—D. W. J.

LEOPOLD, A. S., and R. A. MCCABE. 1957. Natural history of the Montezuma Quail in Mexico. Condor, **59:** 3–26.—*Cyrtonyx montezumae* is characteristic of ungrazed pine-oak forest where it feeds largely on forbs, sedges, and insects in the understory. Grazing eliminates the plants and quail. Cold winters or dry summers cause variations in population density as does quality of habitat. Winter coveys (apparently family groups) break up as pairing commences in April and May, this being followed by nesting from May to July. Young hatch in 25–26 days in July and August when insects are abundant. In the fall, diets are shifted to bulbs as coveys are established on winter ranges.—D. W. J.

MEDINA PADILLA, G. 1957. Sobre la Avifauna de "El Paito" y la nidificación de Galbula ruficauda. Bol. Mus. Cienc. Nat. (Caracas, Venezuela), **1**; no. 3–4, July–Dec., 1955 (1957), 196–200. (In Spanish).—Miscellaneous ecological and nesting observations recorded near Valencia, State of Carabobo, Venezuela. *Galbula ruficauda* breeds at the beginning of the rainy season, usually making its nesting tunnels in cut banks in gullies. In level terrain several were found in the sides of a hole where earth for building construction had been removed, and once a nest was encountered in an excavation in a termitarium located at the base of a tree.

RIPLEY, S. D. 1957. Notes on the Horned Coot, *Fulica cornuta* Bonaparte. Postilla, **30**: 8 pp.

RYDER, R. A. 1957. Avian-pinniped feeding associations. Condor, **59:** 68–69.

SKUTCH, A. F. 1957. The incubation patterns of birds. Ibis, **99:** 69–93.—A review of the methods of incubation in birds. The roles of the sexes and the timing patterns are shown to vary between and within discrete groups. Incubation by both sexes is postulated as primitive. The wide variation is suggested as being possible only because there is no strong selection on patterns of incubation, especially in the tropics.—R. F. J.

SUTTON, G. M., and D. F. PARMELEE. 1955. Nesting of the Horned Lark on Baffin Island. Bird Banding, **26:** 1–18.—Nesting and breeding behavior, parental care, behavior of young, and survival are described. Additional notes on distribution and coloration are included.—W. J. H.

TUTT, H. R. 1955. Observations on a pair of Nightjars at the nest. British Birds, **48:** 261–266.—Includes observations of lure-flights in both sexes, practice-flights in the nestlings, feeding activities, and call-notes of *Caprimulgus europaeus*. Feeding of chicks occurs in two dusk and dawn periods totalling no more than 2½ hours in the 24. The nest site was occupied by the nestlings for a total of six weeks. Vertical flights by the nestlings as high as 6 feet are described.—M. T. M.

YTREBERG, N.-J. 1956. Contribution to the breeding biology of the Black-headed Gull (*Larus ridibundus* L.) in Norway. Nytt Mag. Zool., **4:** 5–106.—A detailed study of nesting from the start of nest-building to the end of incubation.—R. W. S.

MANAGEMENT AND CONSERVATION

CRAIGHEAD, J. J., and D. S. STOCKSTAD. 1956. Measuring hunting pressure on Canada Geese in the Flathead Valley. Trans. 21st. N. Amer. Wildl. Conf., 210–238.—"During 1953, 1954, and 1955, data were gathered on Canada goose numbers, goose movement, hunting pressure and goose kill in the Flathead Valley of Montana in order to evaluate the dynamics of hunting pressure." A direct relationship was found between the number of geese killed and crippled and population levels, the number of geese moving and hunting pressure. The most

promising management refinements are the control and manipulation of hunting pressure and goose movement.—S. T. D.

GOLLOP, J. B. 1956. The use of retrievers in banding flightless young Mallards. Trans. 21st. N. Amer. Wildl. Conf., 239–248.—Describes habitats, techniques, efficiency, and costs involved in using retrievers as aids in banding and concludes that "to catch an adequate, well-distributed sample of mallards (and pintails) in the "grassland" habitat of southwestern Saskatchewan and southeastern Alberta, the most efficient and practical technique is the use of retrievers."—S. T. D.

KIEL, W. H., JR., and J. T. HARRIS. 1956. Status of the White-winged Dove in Texas. Trans. 21st. N. Amer. Wildl. Conf., 376–389.—Destruction of nesting habitat, predation, hunting pressure, and variations in food supply have reduced populations of *Zenaida asiatica* in the lower Rio Grande Valley of Texas to the extent that its status as a game bird is no longer secure. The most urgent need is the preservation of native brushland for nesting cover and to provide the opportunity for carrying out ecological studies.—S. T. D.

LOSTETTER, C. H. 1956. Environmental control in waterfowl. Trans. 21st. N. Amer. Wildl. Conf., 199–209.—Recognizes reductions in waterfowl habitat brought about by expanding agriculture and describes corrective measures taken in the Pacific Flyway, particularly California. Federal and state management units, on which programs of water level manipulation and planting of cultivated and natural waterfowl food plants have been established, are discussed both functionally and financially. The role of private lands in providing needed waterfowl habitat is also stressed.—S. T. D.

NEELY, W. W. 1956. How long do duck foods last underwater? Trans. 21st. N. Amer. Wildl. Conf., 191–198.—Data are presented on the percentage of deterioration of seed samples of 25 plant species upon 90 days exposure underwater in trays or plastic screen envelopes.—S. T. D.

PALMER, W. L. 1956. Ruffed Grouse population studies on hunted and unhunted areas. Trans. 21st. N. Amer. Wildl. Conf., 338–345.—A study on two similar areas in northeastern lower Michigan, one heavily hunted and the other unhunted, was initiated during the population high of 1950 and carried through the low of 1954. It was found that a 40 per cent removal of the population by hunting produced no detrimental effects on the subsequent fall population. Thus a two- or three-month grouse season in Michigan would probably not be excessive.—S. T. D.

PETERS, H. S. 1956. Banding—a key to dove management. Trans. 21st. N. Amer. Wildl. Conf., 365–375.—Reviews briefly the results of a program begun in 1920 in which 145,000 Mourning Doves have been banded, providing a return from all sources of 3.7 per cent. Past efforts have centered on banding large numbers of doves, but present needs emphasize nestlings to provide information on the movement of doves of known origin.—S. T. D.

UHLER, F. M. 1956. New habitats for waterfowl. Trans. 21st. N. Amer. Wildl. Conf., 453–469.—Describes an experimental study being carried out at the Patuxent Research Refuge, Laurel, Maryland, designed to demonstrate the conversion of waste lands and waters into habitat useful to breeding and wintering waterfowl. Preliminary results show utilization of recently developed areas by 60 kinds of shorebirds, marsh birds, and waterfowl.—S. T. D.

WADE, D. E., H. M. STEELE and G. H. BROWN. A method of teaching waterfowl identification. Trans. 21st. N. Amer. Wildl. Conf., 602–607.—South Carolina's approach in teaching waterfowl identification to conservation officers is described

with comments on the application of such a program to general conservation awareness and education.—S. T. D.

WALLACE, R. F. 1956. An evaluation of wildlife resources in the State of Washington. Economic and business studies, Bull. 28: State College of Washington.

WESTERSKOV, K. 1955. Notes on the post-juvenile moult and first-winter plumage in the Pheasant. British Birds, **48:** 308–311.—Agrees with the findings of Petrides (1942) and Linduska (1943) upon which aging techniques are now based. Unlike other gallinaceous birds all ten primaries are replaced during the post-juvenile molt. Statements in Witherby *et al.* need correcting.—M. T. M.

MIGRATION AND ORIENTATION

BUTTERFIELD, A., and K. WILLIAMSON. 1955. The passage of Black Terns through Britain in autumn 1954. British Birds, **48:** 300–307.—The fall passage of *Chlidonias niger* was unusually large and continued into November. The peaks of passage were associated with cyclonic weather (contrast peaks during anticyclonic weather in spring 1954), and frontal weather which induces precipitation which is unfavorable to an insect-feeder. Winds were between NE and SE in the North Sea and English Channel areas at peak passage and the birds escaped by moving downwind.—M. T. M.

FORSTER, G. H. 1955. Thermal air currents and their use in bird-flight. British Birds, **48:** 241–253.—A very clear and concise account of the dynamics of thermal air currents and the conditions under which they arise. An inversion of temperature, when upper layers of air are warmer than those below, can be identified by flat-topped clouds or levelling off of chimney smoke, and are poor conditions for soaring. Cumulus formation is an indication of warm air rising and the higher the cumulus base the stronger the thermals from which they arise on the ground (heated spots). After midday ground surface begins to cool and an inversion forms. Only above it is gliding possible. Maximum height of the inversion is reached just before sunrise. Topographic or vegetational demarcations (e.g. seashore) cause thermals which continue at night over the sea, rivers and estuaries, especially in cases of sudden onset of cold weather. Accipitres use topographic (e.g. coastal) thermal lines as guiding lines in migration. Slope currents are also discussed. Albatrosses are reputed to use wind shear i.e. change in wind speed with altitude since it creates "standing waves." The implications of the physical formation of thermal currents should help us to interpret temporal features of migration more clearly, as well as the routes followed.—M. T. M.

GUICHARD, K. M. 1957. The spring migration in Tripolitania—1955. Ibis, **99:** 106–114.

LACK, D., and M. G. RIDPATH. 1955. Do English Woodpigeons migrate? British Birds, **48:** 289–292.—Apparent visible migration of *Columba palumbus* through Great Britain has been observed. At least in Kent and Sussex, birds coming in from the sea were *not* migrants from France. Both there and near Oxford large roosts existed nearby. But these roosts showed a bias to disperse southwards in the mornings (little return noted) and this suggested a connection between migratory movements and the roosts. An enquiry is instituted.—M. T. M.

RICHDALE, L. E. 1957. Recovery of sooty shearwater in northern hemisphere. Ibis, **99:** 116.—Report of the recovery of a *Puffinus griseus* on the Coronado Islands, Mexico, July, 1955. The bird was banded by Richdale in New Zealand in February, 1950, and was known to have bred there in 1950, 1953, and 1954.—R. F. J.

SHULER, J. B., JR. 1956. Bird navigation as related to migration. Chat, **20**: 65–71.

STEVENSON, H. M. 1957. The relative magnitude of the Trans-gulf and circum-gulf spring migrations. Wilson Bull., **69**: 39–77.—The relative abundance of spring migrants in areas around the Gulf of Mexico and the southern U. S. was obtained from the field observations of many cooperators. The spring arrival dates for different localities were obtained from the literature and other sources. These data were plotted on maps, by species, and from these, inferences were made as to whether the migration was primarily across the Gulf or around it to the east or to the west. 179 species were studied; maps are presented for 30 species. Approximately 40 species migrated primarily across the Gulf.—J. T. T.

TAIT, G. M. 1957. American-ringed turnstone recovered in Portugal. Ibis, **99**: 122–123.—One *Arenaria interpres* was shot at Fão, Portugal, on September 11, 1955; it had been banded as a nestling on Ellesmere Island on July 6, 1955.—R. F. J.

PHYSIOLOGY

BARTHOLOMEW, G. A., and T. J. CADE. 1956. Water consumption of House Finches. Condor, **58**: 406–412.—Caged *Carpodacus mexicanus* were exposed to experiments which showed that more water was consumed at higher ambient temperatures and that body weight was reduced by about 15 per cent when the birds were deprived of water. When succulent food was available even though water was not, body weight was maintained fairly well. These experimental results would offer some explanation for the occurrence of this species on the desert near springs, tanks, and other available water. Data taken from the literature seem to indicate that the smaller the bird, the greater its need for surface water (or perhaps a succulent diet).—D. W. J.

NORRIS, R. A. 1957. On the appraisal of fat condition in birds. Oriole, **21**: 2–9.—A significant discussion relating to field and laboratory techniques involving the evaluation of fat deposits.—D. W. J.

STEGEMAN, L. C. 1955. Weights of some small birds in Central New York. Bird Banding, **26**: 19–27.—Data are based on 1650 trapped and 800 shot birds. Birds shot but not mangled average 4.3 per cent lighter than trapped individuals. In general, insectivorous birds are heaviest in the fall, seed-eaters in the spring. Hourly variation is considerable, increases taking place in morning and late afternoon. The nocturnal decrease averaged at least 10 per cent. Development of the trap habit does not affect weights.—W. J. H.

TAXONOMY AND PALAEONTOLOGY

BLAKE, C. H. 1954. Notes on the wing length of the Eastern Purple Finch (*Carpodacus p. purpureus*). Bird Banding, **25**: 97–101.—Analysis based on over 1000 birds taken at banding stations in Massachusetts.—W. J. H.

BOWERS, D. E. 1956. A study of methods of color determination. Syst. Zool., **5**: 147–160, 182.—A good discussion of the methods for the designation of colors based on both visual and machine determinations.—R. W. S.

DILGER, W. C. 1956. Relationships of the thrush genera *Catharus* and *Hylocichla*. Syst. Zool., **5**: 174–182.—*Hylocichla mustelina* is closely related to the genus *Turdus*. The other species formerly included in *Hylocichla* should be placed in the genus *Catharus*.—R. W. S.

MILLER, L. 1956. A collection of bird remains from the Pliocene of San Diego,

California. Proc. Calif. Acad. Sci., Ser. 4, **28**: 615–621.—*Lechusa stirtoni* (Strigidae), new genus and species, and seven species of water birds recorded.

MILLER, L. 1957. Bird remains from an Oregon Indian midden. **Condor, 59:** 59–63.—From an Indian mound about 8000 years old, approximately 9000 bird bones were examined. Sixteen avian types were identified, the most abundant being *Larus, Phalacrocorax, Haliaeetus,* and *Gymnogyps.* Two especially unusual "finds" were *Coragyps occidentalis* and *Gymnogyps californianus.* The absence of wading, diving, and gallinaceous birds was of interest.—D. W. J.

NORRIS, R. A., and G. L. HIGHT, JR. 1957. Subspecific variation in winter populations of Savannah Sparrows: a study in field taxonomy. Condor, **59:** 40–52.—In this important paper the results of banding and studying 559 *Passerculus sandvicensis* in the Savannah River Plant area, South Carolina are reported. By using initially a series of museum-identified, racially-determined specimens, later field taxonomy was employed wherein live birds were assigned racial designations. Five races were found, but more than half the total birds examined were considered to be intergrades. Dark races and light races showed no differential habitat selection in the study area of old abandoned fields. Weights and wing measurements are given for some of the large sample.—D. W. J.

PAYNTER, R. A., JR. 1957. Taxonomic notes on the New World forms of *Troglodytes.* Breviora, Mus. Comp. Zool., **71:** 15 pp.

RAND, A. L. 1957. Two new species of birds from Angola. Fieldiana Zool., **39:** 41–45.—*Muscicapa gabela* and *Prionops gabela,* new species, both from 15 kilometers south of Gabela, Angola.—M. A. T.

RAND, A. L. 1957. The subspecies of the Bush Shrike *Laniarius fulleborni* (including *L. poensis*). Fieldiana, Zool., **39:** 47–50.—Two new subspecies, *L. f. usambaricus* from Usambara, and *L. f. ulugurensis* from the Uluguru Mountains, are described.—M. A. T.

RIPLEY, S. D. 1957. New birds from the western Papuan Islands. Postilla, **31:** 4 pp.—*Aepypodius arfakianus misoliensis, Eos squamata attenua, Crateroscelis murina fumosa, Gerygone magnirostris occasa,* and *Xanthotis chrysotis austera,* new subspecies.

WALLACE, D. I. M. 1955. The mixing of the races of the Yellow Wagtail in Kenya. British Birds, **48:** 337–340.—Records of *Motacilla flava* in Kenya. The race *M. f. flavissima* (British breeding race) probably crosses Africa from west to east in winter in small numbers.—M. T. M.

WILLIAMS, J. G. 1957. The re-discovery and status of *Ploceus golandi.* Ibis, **99:** 123–124.—Report of taking the second specimen of this weaver in Kenya; it had been doubted that the species was real.—R. F. J.

WILLIAMSON, F. S. L. 1957. Hybrids of the Anna and Allen hummingbirds. Condor, **59:** 118–123.—A fifth hybrid between *Selasphorus sasin* and *Calypte anna* is described in detail. Evidence is marshalled to question the relegation of these two species into separate genera.—D. W. J.

WILLIAMSON, K., and FERGUSON-LEES, I. J. 1955. Plumage and structural characters in the Yellow-headed Wagtail. British Birds, **48:** 358–362.—A detailed discussion of the identification of *Motacilla citreola* with especial emphasis on its similarity to the Eastern Blue-headed Wagtail (*M. flava simillima*) of Kolyma-Kamchatka —M. T. M.

NOTES AND NEWS

We regret to announce the death of William Rowan, Fellow of the A.O.U., on June 30, 1957.

It is a pleasure to inform our readers that Alden H. Miller has been elected to the National Academy of Sciences.

Dr. Raymond A. Paynter, Jr., Associate Curator of Birds at the Museum of Comparative Zoology at Harvard, is leading an expedition to study the birds of Nepal, India, and Pakistan. The expedition is scheduled to arrive in India this September and to return in August of 1958. It is being sponsored jointly by the M.C.Z. and the Peabody Museum of Yale University.

To all American ornithologists!

Several AOU members have been corresponding recently with Hungarian ornithologists, some inside Hungary and some who fled. Their situation is critical and with another winter coming on it is becoming desperate in several cases. The Hungarian National Museum containing 80,000 bird skins, has been completely destroyed and the entire staff is destitute. Some of these men are elderly, some of them have dependent children.

The AOU has set up a committee to coordinate the help to fellow ornithologists which you, their colleagues, want to send. We CAN help them although there are many restrictions. Will all of you who can spare anything from a dime for postage to the price of an entire food package, from your old wool shirt to your overcoat please contact Fred Greeley, Illinois Natural History Survey, Urbana, Illinois. If you will specify what you can spare, we have a file of names, addresses and needs. We will get you together with someone who really needs you. Many thanks.

THE AMERICAN ORNITHOLOGISTS' UNION

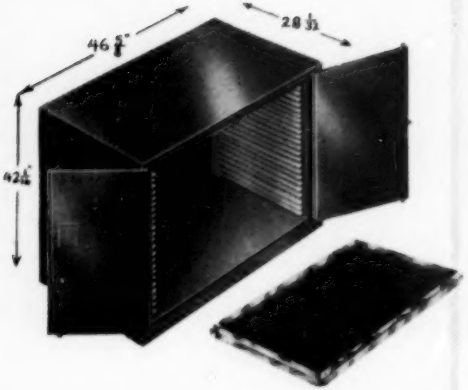
Rates and Space Dimensions for Advertisements in The Auk

Space	*Dimensions*	*Per Year (4 issues)*	*Per issue*
Full page	4½″ x 7½″	$200	$65
½ page	4½″ x 3⅝″	$120	$40
⅓ page	4½″ x 2⅜″	$ 75	$25
¼ page	4½″ x 1 13/16″	$ 60	$20

Advertisements suitable for inclusion in The Auk are solicited.

Address inquiries and space orders to:

CHARLES G. SIBLEY, *Treasurer*
Fernow Hall, Cornell University
Ithaca, New York



Skin Case #201 for Large Trays

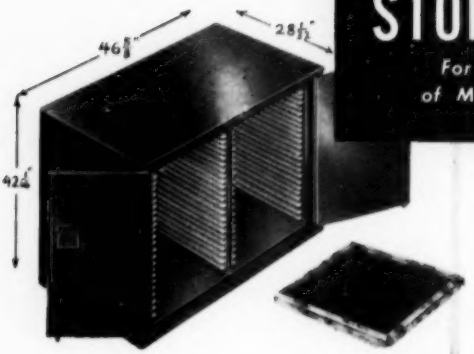
SKIN CASES FOR MAXIMUM PROTECTION CONVENIENCE ECONOMY!

Lane

ZOOLOGICAL AND ORNITHOLOGICAL

SPECIMEN STORAGE CASE

For Protective Storage of Mammal & Bird Skins



Skin Case #202 for Small Trays

- Locked "Live Rubber" Seal
- Sturdy double panel doors
- Locking mechanism secures both doors
- Tray guides permit maximum position of tray positions
- Fumigant Compartment
- Specimen Trays of aluminum and masonite — light weight — easy to handle.

FOR ILLUSTRATED BROCHURE WRITE

Institutional Division CHAS J Lane CORP

105 CHAMBERS STREET, NEW YORK 7, N. Y.

THE AUK

A Quarterly Journal of Ornithology

ORGAN OF THE AMERICAN ORNITHOLOGISTS' UNION

For publication in 'The Auk,' articles or notes must present material that is of significance to ornithologists and that has not been published elsewhere. All manuscripts should be typewritten, double spaced, with wide margins. Titles should be brief. Terminal bibliographies are used as a rule for long articles. Only works actually cited in the text are to be included in these bibliographies; works not so cited will be deleted by the editors. Where fewer than five references to literature are made, they may be inserted in parentheses in the text. References in manuscript for 'General Notes' should be in the text. Consult issues of 'The Auk' since January, 1949, for style of citation. Long articles should be summarized briefly. Footnotes, Roman numerals, and ruled tables are to be avoided. Acknowledgments belong in the text. Line drawings must be in India ink on white paper or drawing board; usually these should be planned for at least one-half reduction when printed. Thus, details and lettering must be correspondingly large. Legends must be brief. Photographs must be hard, glossy prints of good contrast. Common and scientific names of North American birds should follow the A.O.U. Check-List and supplements except in taxonomic papers giving critical discussions.

Proofs of all articles and notes will be sent to authors. Reprints from articles, 'General Notes,' and 'Correspondence' are to be paid for by the author. These must be ordered from the Editor on the blanks sent with the proof and must be returned with the proof. Printed covers can be furnished at additional cost.

All articles and notes submitted for publication and all books and publications intended for review should be sent to the Editor.

ROBERT W. STORER, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

All persons interested in ornithology are invited to join the American Ornithologists' Union. Application may be made to the Treasurer; dues for Members are $4.00 per year. 'The Auk' is sent without charge to all classes of members not in arrears for dues.

Send changes of address, claims for undelivered or defective copies of 'The Auk,' and requests for information relative to advertising, subscriptions, back numbers of 'The Auk,' as well as for other publications of the Union, to the Treasurer.

CHARLES G. SIBLEY, *Fernow Hall, Cornell University, Ithaca, New York.*

OFFICERS OF THE
AMERICAN ORNITHOLOGISTS' UNION

President: ERNST MAYR, Museum of Comparative Zoology, Harvard University, Cambridge 38, Massachusetts.

First Vice-President: GEORGE H. LOWERY, JR., Museum of Zoology, Louisiana State University, Baton Rouge, Louisiana.

Second Vice-President: AUSTIN L. RAND, Chicago Natural History Museum, Chicago 5, Illinois.

Editor: ROBERT W. STORER, Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

Secretary: HAROLD F. MAYFIELD, River Road, RFD, Waterville, Ohio.

Treasurer: CHARLES G. SIBLEY, Fernow Hall, Cornell University, Ithaca, New York.

ALFRED M. BAILEY
Museum Director—Audubon Screen Tour Lecturer

Says:

Audubon Field Notes is an extremely valuable publication to us at the Denver Museum of Natural History. We are compiling data for a book, "The Birds of Colorado," and we find many helpful notes in the seasonal lists. Field workers are so scattered throughout the state that it is a great service to have these records appear regularly so that we may compare them with those of neighboring states. By publishing the observations, the Audubon Society has preserved the data in convenient form, and has encouraged field observers to greater efforts, with a consequent furthering of information on life histories of birds.

AUDUBON FIELD NOTES

SUBSCRIBE TODAY!

Subscription for one year..... $3.00 **Subscription for two years..... $5.50**

Subscription for three years. $7.50

(Separate copies of April issue—Christmas Bird Count $2.00)

1130 Fifth Avenue, New York 28, N. Y.

MIST NETS

Complete assortment of mist nets available. These are of the best grade pure nylon construction throughout.

Net No. 1—60 denier/2 ply, 1½" mesh x 7' width x 18' length, $2.00
No. 2 x 30' L, $2.50; No. 3 x 42' L, $3.00; No. 4 x 60' L, $4.00

Net No. 5—110 denier/2 ply, 2½" mesh x 7' W x 18' L, $2.25
No. 6 x 30' L, $2.50; No. 7 x 42' L, 3.75; No. 8 x 60' L, $5.50

Net No. 9—210 denier/2 ply, 4" mesh x 7' W x 18' L, $1.75
No. 10 x 30' L, $2.25; No. 11 x 42' L, $2.75; No. 12 x 60' L, $3.75

All prices include postage. 10% discount on orders of ten nets or more (assorted) mailed to one address. Please state Federal Permit number indicating that it has been amended to allow use of mist nets.

BLEITZ WILDLIFE FOUNDATION
1001 North McCadden Place, Los Angeles 38, California

AMERICAN ORNITHOLOGISTS' UNION

"Recent Studies in Avian Biology" **$7.50**
479 pages, bound

"Biographies of Members of the A.O.U.
Bound **5.00**
Unbound **4.00**

Ten Year Indexes to The Auk
Bound **4.00**
Unbound **3.00**

Order from: CHARLES G. SIBLEY, Treasurer
Fernow Hall, Cornell University
Ithaca, New York